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PROCEEDINGS  
OF  
The Academy of Natural Sciences  
OF  
PHILADELPHIA

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VOLUME LXX

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1918

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1919

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PROCEEDINGS  
OF THE  
ACADEMY OF NATURAL SCIENCES  
OF  
PHILADELPHIA.

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1918.

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January 15.

HENRY SKINNER, M.D., Sc.D., in the Chair.

Thirty-one persons present.

The Publication Committee reported the presentation of papers for publication as follows:

"The Meteor Crater of Arizona," by Beeby Thompson.

"Contributions a l'histoire naturelle du fer du Canyon Diablo," par Stanilas Meunier.

"New and little-known fishes from the Philippine Islands," by Henry W. Fowler.

Dr. Harley Stamp made a communication entitled: *An Anthropological Amateur in Alaska, Siberia, and the Arctic*, illustrated by colored lantern slides. (No abstract).

The deaths of Caleb Cresson, December 30, 1917, and Joseph P. Remington, January 1, 1918, members, were announced.

Andrew J. Carty and Annabella E. Richards, were elected members.

The following was ordered to be printed:

## NEW AND LITTLE-KNOWN FISHES FROM THE PHILIPPINE ISLANDS.

BY HENRY W FOWLER.

During the past summer the writer had opportunity to study the collection of fishes in the Commercial Museums of Philadelphia, obtained some years previously from the Philippine Government. Dr. William P. Wilson, the Director of the Commercial Museums, very kindly offered every assistance in this work and through him a series of the duplicates, including the more important species of scientific interest, have been received into the collection of the Academy. Though the specimens are usually without detailed localities, most were probably obtained near Manila. Others were collected and shipped to Manila, so that no localities are here noted other than the islands as a whole. In some instances the native names were also preserved, although many have been lost prior to my examination.

The characteristic richness in species of the great East Indian fauna is at once apparent in even a cursory study of such a collection. Twenty-six species are described as new and figured. An imperfectly known rare cardinal-fish is redescribed.

***Scoliodon walbeehmii* (Bleeker).**

Four small examples, the largest about 305 mm. Mouth little longer than wide. Teeth entire or nearly so. Upper jaw with short labial fold. Anal fin length little less than its distance from ventrals. Outer pectoral angle nearly a right angle.

***Mobula eregoodoo-tenkee* (Cuvier).**

Young example with umbilical cord and egg-sac. Tail short, not half length of disk. Teeth numerous, little distinct. Cephalic fins curved inward, and front flange folds upward so tips well overlap. Last gill-openings each side wider than interspace. Small dorsal over ventral. Skin smooth. Color uniform pale brown, edges of cephalic fins darker. Eyes slaty. Disk length 254 mm., width much greater.

***Pisodonophis cancrivorus* (Richardson).**

Günther gives coloration uniform, with more or less distinct blackish spot forward on dorsal. Bleeker quotes Richardson that the lateral line is not present and in the latter's figure it is so indicated.

My five examples all show it. Richardson's figure has a much smaller eye and has no pores behind the eye. Jordan and Richardson give the chin and throat pale yellow in life, and the pectoral yellowish; in my examples, muzzle and head below dusky or soiled blackish.

***Pisoodonophis bore* (B. Hamilton).**

Several, with very fine longitudinal wrinkles or grooves, mostly parallel, on pharynx. Jordan and Richardson omit this species from their check-list, though Günther previously recorded an adult from Zebu.<sup>1</sup>

***Hemiramphus limbatus* Valenciennes.**

Large series, all small, and with broken beaks. These show: Head  $4\frac{1}{2}$  to  $4\frac{1}{4}$ ; depth  $7\frac{2}{3}$  to  $8\frac{2}{3}$ ; D. II, 12 or 13; A. III, 12 or 13; scales 46 to 52 in lateral row to caudal base, and 6 to 9 more on latter; predorsal scales 42 to 47; snout  $2\frac{2}{3}$  to 3 in head measured from upper jaw tip; eye  $3\frac{2}{3}$  to  $4\frac{1}{2}$ ; maxillary 3 to  $3\frac{2}{3}$ ; interorbital  $3\frac{1}{2}$  to 4; rakers 5 to 7 + 10 to 17, lanceolate, about  $\frac{2}{3}$  of filaments and latter 2 in eye; length 80 to 118 mm.

Probably *Oxyporhamphus brevis* Seale belongs in *Arrhamphus* Günther (type *A. sclerolepis* Günther) or the short-billed forms with short pectorals.

***Mugil rathveni* sp. nov. Fig. 1.**

Head  $3\frac{2}{3}$ ; depth  $3\frac{2}{3}$ ; D. IV-I, 8; A. III, 8, 1; P. I, 14; V. I, 5; scales 30 in lateral series from gill-opening above to caudal base, and 3 more large ones on latter; 11 scales between second dorsal and anal origins; 20 predorsal scales; head width  $1\frac{1}{2}$  its length; head depth  $1\frac{1}{2}$ ; snout  $3\frac{1}{2}$ ; eye  $4\frac{1}{2}$ ; mouth width  $3\frac{2}{3}$ ; interorbital  $2\frac{2}{3}$ ; first dorsal spine  $1\frac{1}{2}$ ; first dorsal ray  $1\frac{1}{2}$ ; third anal spine  $2\frac{1}{2}$ ; first anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body elongate, with fusiform contour, compressed, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth about  $1\frac{1}{2}$  its length.

Head robust, somewhat constricted below, profiles alike. Snout moderately broad, convex as viewed above, length nearly half its

<sup>1</sup> The American species described by Goode and Bean and referred to *Pisoodonophis* is evidently different in its serpent-like head, strong neck-muscles and constriction of the head somewhat as in *Derichthys*. It may, therefore, stand as a distinct subgenus.

***Omochelys* subgen. nov.**

Type *Pisoodonophis cruentifer* Goode and Bean.

Differs from subgenus *Pisoodonophis* in having the dorsal inserted behind the pectoral.

(*Ομοῦς*, cruel; *εὐχέλυσ*, eel; with reference to its savage habits.)



width. Eye circular, hind edge about half a pupil-diameter before center in head length. Adipose-eyelids well developed, posterior extends over last third of eye and anterior very narrow. Mouth slightly inferior, corner falls about opposite front nostril. Mandibular angle very broad, obtuse, symphysis forming little knob which fits in depression above. Teeth minute, uniserial in upper jaw, obsolete in mandible. Lips rather fleshy, upper jaw width about half of pupil. Inner buccal folds moderately broad, upper little broader. Tongue small, tip free, elongate. Maxillary exposed, not quite to eye. Lower preorbital edge straight, with minute denticles. Front nostril about last  $\frac{2}{3}$  in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit, little nearer front nostril than eye. Interorbital broadly convex.

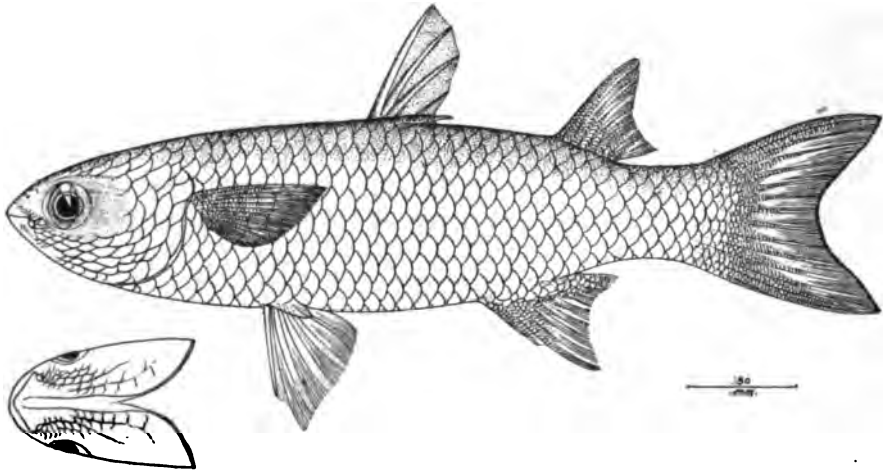


Fig. 1.—*Mugil ruthveni* sp. nov.

Gill-opening forward about midway in eye. Rakers about 30+46, slender, fine,  $2\frac{1}{2}$  in filaments and latter about equal eye. Pseudo-branchiæ about half of gill-filaments. Isthmus narrowly constricted, smooth.

Scales large, in even longitudinal series. Head scaly, scales smaller below, and extends well forward on snout though not to its edge. Scaly pointed flap along spinous dorsal base  $1\frac{1}{2}$  in fin. Short scaly pectoral flap (damaged). Axillary ventral flap  $2\frac{1}{2}$  in fin. Broad scaly flap between ventral bases half of fin. Soft dorsal and anal scaly over basal halves. Caudal largely covered with small scales. Pectoral with small scales basally. Ventral scaly. Three scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal inserted about midway between front of eye and caudal base, first spine longest and depressed fin  $1\frac{1}{2}$  to soft dorsal origin. Latter nearly an eye-diameter nearer caudal base than spinous dorsal origin, depressed fin  $1\frac{1}{2}$  to caudal base. Anal origin nearer caudal base than ventral origin, depressed fin  $1\frac{1}{2}$  to caudal base. Caudal emarginate behind,  $3\frac{1}{2}$  in head and trunk, lobes about equal. Pectoral short, broad,  $1\frac{1}{2}$  to spinous dorsal origin. Ventral inserted about opposite middle in depressed pectoral,  $1\frac{1}{2}$  to anal. Vent close before anal origin.

Color in alcohol dull brownish generally, slightly tinted olivaceous on back. Fins all pale, and hind caudal edge narrowly dusky. Iris pale slaty. Peritoneum blackish. No dark blotch at shoulder or pectoral base.

Length 240 mm.

Type, No. 47,478, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Only the type known. The dark hind caudal edge is suggestive of *Mugil sundanensis* Bleeker,<sup>2</sup> but that species has 9 branched anal rays, preorbital deeply notched, snout long as eye, etc.

(Named for Dr. Alexander G. Ruthven, of the University of Michigan, well known among leading herpetologists, who has written on Michigan fishes.)

*Mugil ogilbyi* sp. nov. Fig. 2.

Head  $3\frac{1}{2}$ ; depth  $3\frac{1}{2}$ ; D. IV-I, 8; A. III, 9; P. I, 14; V. I, 5; scales 28 in lateral series from gill-opening above to caudal base and 4 more large ones on latter; 10 scales between second dorsal and anal origins; 20 predorsal scales; head width  $1\frac{1}{2}$  its length; head depth  $1\frac{1}{2}$ ; snout  $3\frac{1}{2}$ ; eye  $4\frac{1}{2}$ ; mouth width  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; first dorsal spine  $1\frac{1}{2}$ ; first dorsal ray  $1\frac{1}{2}$ ; third anal spine  $2\frac{1}{2}$ ; first anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body elongate, contour fusiform with lower profile slightly more convex, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth  $1\frac{1}{2}$  its length.

Head robust, very slightly constricted below, lower profile slightly more convex and inclined. Snout broad, widely convex as viewed above, length about  $\frac{2}{3}$  its width. Eye circular, hind edge anterior to center in head length about diameter of pupil. Adipose-eyelids

<sup>2</sup> Nat. Tijds. Ned. Indie, IV, 1853, p. 265. Benculen-Sumatra. Batavia, Java.

Günther, Cat. Fish. Brit. Mus., III, 1861, p. 425 (copied).

little developed, posterior extends over last fifth of eye and anterior very narrow. Mouth little inferior, and corner falls opposite front nostril. Mandibular angle very broad, obtuse, symphysis forming little knob which fits in depression above. Teeth very minute, uniserial in upper jaw, apparently absent in lower. Lips rather fleshy, width of upper about  $\frac{4}{5}$  of pupil. Inner buccal folds moderately broad, upper little broader. Tongue small, tip free, elongate. Maxillary exposed, about to eye. Lower preorbital edge slightly curved, with few very minute obsolete denticles. Front nostril about last  $\frac{2}{3}$  in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit, little nearer front nostril than eye. Interorbital broadly convex.

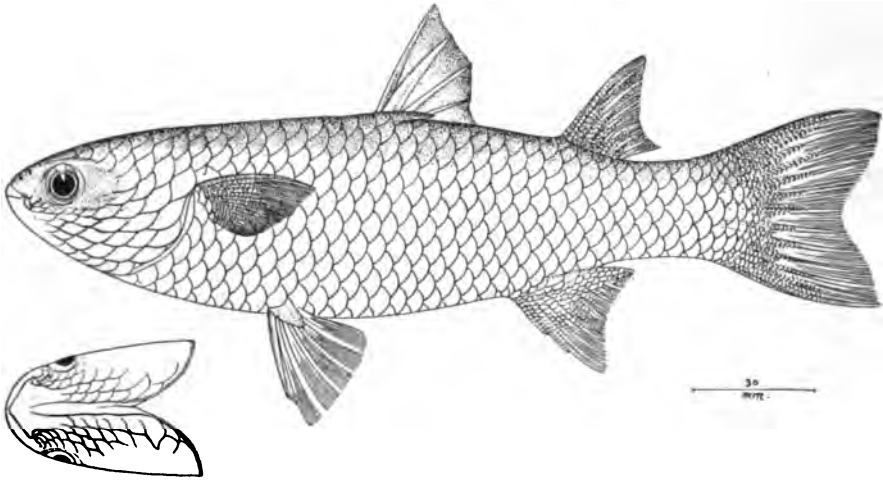


Fig. 2.—*Mugil ogilbyi* sp. nov.

Gill-opening forward about opposite front pupil edge. Rakers about  $35+52$ , slender, fine,  $2\frac{1}{2}$  in filaments and latter  $1\frac{1}{8}$  in eye. Pseudobranchiæ about  $1\frac{1}{2}$  in gill-filaments. Isthmus narrow, constricted, with median groove.

Scales large, in even lengthwise series. Head scaly, scales smaller below, and extend well forward on snout, though not to its edge. Scaly pointed flap along spinous dorsal base half depressed fin length. Scaly flap in pectoral axil  $\frac{1}{2}$  of fin. Axillary ventral scaly flap  $2\frac{1}{2}$  in fin. Broad scaly flap between ventral bases 2 in fin. Soft dorsal and anal scaly over basal halves. Caudal largely scaly, fewer scales about pectoral basally. Ventral with many small scales. Four scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal inserted midway between hind nostril and caudal base, first spine very slightly longer than second, depressed fin  $1\frac{1}{2}$  to soft dorsal origin. Last slightly nearer caudal base than spinous dorsal origin, depressed fin  $1\frac{1}{2}$  to caudal base. Anal origin little nearer caudal base than ventral origin, depressed fin  $1\frac{1}{2}$  to caudal base. Caudal emarginate behind, about equals head in length, lobes about equal. Pectoral short, broad,  $1\frac{1}{2}$  to spinous dorsal. Ventral inserted near last third of depressed pectoral, reaches half way to anal. Vent close before anal origin.

Color in alcohol dull brownish generally, upper surface tinged with olivaceous. Pockets of fallen scales exposed with more or less dusky. Traces of darker lengthwise streaks, one to each row of scales along back. Dorsals and caudal tinted with pale dusky, though hind edge of latter not dark. Pectoral brownish and other fins pale. Iris pale slaty. Peritoneum blackish. No dark shoulder spot or at pectoral base.

Length 210 mm.

Type, 47,479, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,480, paratype, same data. Head  $3\frac{1}{2}$ ; depth  $3\frac{1}{2}$ ; D. IV-I, 8; A. III, 9, 1; scales 29 in lateral series from gill-opening above to caudal base; 11 scales between second dorsal and anal origins; 20 predorsal scales; snout  $3\frac{1}{2}$  in head; eye  $4\frac{1}{2}$ ; mouth width  $3\frac{1}{2}$ ; inter-orbital  $2\frac{1}{2}$ ; length 205 mm.

This species is closely allied with *Mugil alcocki* Ogilby,<sup>3</sup> but differs in the larger head, deeper body, longer snout, etc. Günther does not give the length of the first dorsal spine, though Ogilby remarks "it is noteworthy that neither Cantor or Bleeker have recorded any mullet having the first dorsal spine prolonged, from any part of the Malay Peninsula and Archipelago."

(Named for Mr. J. Douglas Ogilby, the accomplished Australian Ichthyologist of the Queensland Museum.)

***Mugil philippinus* sp. nov.** Fig. 3.

Head  $3\frac{1}{2}$ ; depth  $3\frac{1}{2}$ ; D. IV-I, 8; A. III, 8; P. I, 13; V. I, 5; scales 30 in lateral series from gill-opening above to caudal base and 3 more large ones on latter; 10 scales between second dorsal and anal origins; 19 predorsal scales; head width  $1\frac{1}{2}$  in its length; head depth  $1\frac{1}{2}$ ;

<sup>3</sup> Ann. Queensland Mus., No. 9, 1908, pp. 21-2. Based on *Mugil subviridis* Day (non Valenciennes).

—Günther, Cat. Fish. Brit. Mus., III, 1861, p. 423, fig. (head below). Madras.



snout 4; eye 4; mouth width  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; first dorsal spine  $1\frac{1}{2}$ ; first dorsal ray  $1\frac{1}{2}$ ; third anal spine 3; first anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body elongate, with fusiform contour, compressed, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth about  $1\frac{1}{2}$  its length.

Head robust, somewhat constricted below, profiles alike. Snout broad, widely convex as viewed above, length about  $\frac{2}{3}$  its width. Eye circular, hind edge little anterior to center in head length. Adipose-eyelids well developed, posterior extends over last third of eye and anterior about half so wide. Mouth little inferior, corner falls very slightly behind front nostril. Mandibular angle very

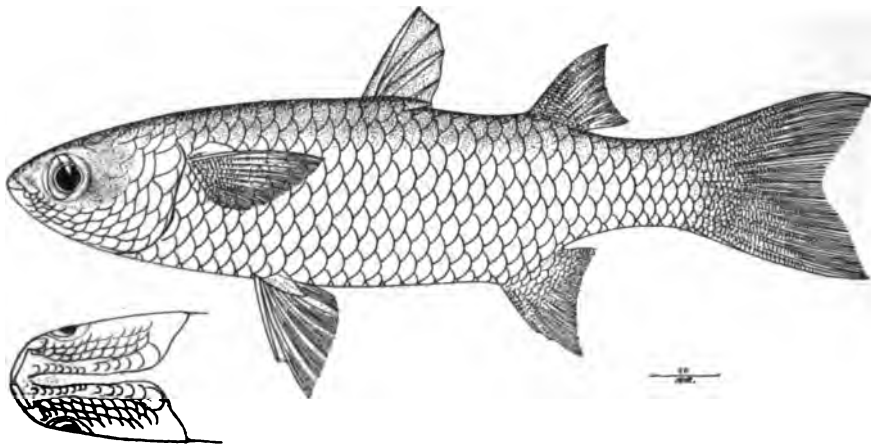


Fig. 3.—*Mugil philippinus* sp. nov.

broad, obtuse, symphysis forming little knob which fits in depression above. Teeth very minute, uniserial in upper jaw, and obsolete in mandible. Lips rather fleshy, width of upper about  $\frac{2}{3}$  of pupil. Inner buccal folds moderately broad, upper little wider. Tongue small, tip free, elongate. Maxillary exposed, about reaches eye. Lower preorbital edge not notched, with a few obsolete denticles. Front nostril about last third in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit midway between front nostril and front eye edge. Interorbital broadly convex.

Gill-opening forward about opposite hind pupil edge. Rakers about 38+48, slender, fine,  $2\frac{1}{2}$  in filaments and latter equal eye. Pseudobranchiæ about  $1\frac{1}{2}$  in gill-filaments. Isthmus narrow, with slight depression.

Scales large, in even longitudinal series. Head scaly, scales smaller below and extend well forward on snout, though not to its edge. Scaly pointed flap along spinous dorsal base about  $1\frac{1}{2}$  of first spine length. Scaly flap in pectoral axil about  $3\frac{1}{2}$  in fin. Axillary ventral scaly flap about  $2\frac{1}{2}$  in fin. Broad scaly flap between ventral bases  $2\frac{1}{2}$  in fin. Soft dorsal and anal scaly over basal halves. Caudal largely covered with small scales from base, pectoral likewise. Three scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal inserted about midway between eye front and caudal base, first spine about as long as second, depressed fin  $1\frac{1}{2}$  to soft dorsal origin. Last about midway between first dorsal origin and caudal base, depressed fin  $1\frac{1}{2}$  to caudal base. Anal origin slightly nearer caudal base than ventral origin, depressed fin  $1\frac{1}{2}$  to caudal base. Caudal emarginate behind,  $3\frac{1}{2}$  in head and trunk, lower lobe slightly longer. Pectoral short, broad,  $1\frac{1}{2}$  to spinous dorsal. Ventral inserted about opposite last fourth of depressed pectoral,  $1\frac{1}{2}$  to anal. Vent close before anal origin.

Color in alcohol dull brownish generally, back and upper surfaces with dull olive shades, belly and below paler. Dorsals and caudal tinted with pale dusky. Iris pale slaty. Fins whitish. Peritoneum blackish.

Length 237 mm.

Type, No. 47,481, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,482, paratype, same data. Head  $3\frac{1}{2}$ ; depth  $3\frac{1}{2}$ ; D. IV-I, 8; A. III, 8; scales 30 in lateral series from gill-opening above to caudal base; 11 scales between second dorsal and anal origins; 19 predorsal scales; snout  $3\frac{1}{2}$  in head; eye  $4\frac{1}{2}$ ; mouth width  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; length 254 mm. This example figure 3.

Differs from *M. ogilbyi* in the fewer (3) scales after depressed spinous dorsal, slightly larger body scales and first dorsal spine not longer than the second.

*Mugil lepidopterus* sp. nov. Fig. 4.

Head 4; depth  $3\frac{1}{2}$ ; D. IV-I, 8; A. III, 9; P. 1, 12; V. 1, 5; scales 30 in lateral series from gill-opening above to caudal base and 3 more large ones on latter; 10 scales between second dorsal and anal origins; 20 predorsal scales; head width  $1\frac{1}{2}$  its length; head depth  $1\frac{1}{2}$ ; snout  $3\frac{1}{2}$ ; eye 4; mouth width 3; interorbital  $2\frac{1}{2}$ ; first dorsal spine  $1\frac{1}{2}$ ; first dorsal ray  $1\frac{1}{2}$ ; third anal spine  $2\frac{1}{2}$ ; first anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle 2; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body moderately elongate, contour fusiform, compressed, deepest at spinous dorsal origin. Caudal peduncle compressed, least depth  $1\frac{1}{2}$  its length.

Head moderately robust, somewhat constricted below, profiles alike. Snout broad, convex as viewed above, length nearly half its width. Eye nearly impinging on upper profile, little advanced before center in head length. Adipose-eyelids well developed, posterior extends over last third of eye and anterior very narrow. Mouth slightly inferior, and corner falls about opposite front nostril. Mandibular angle very broad, obtuse, symphysis forming little knob fitting in depression above. Teeth very minute, feeble and uniserial in upper jaw, apparently absent in lower jaw. Lips little fleshy,

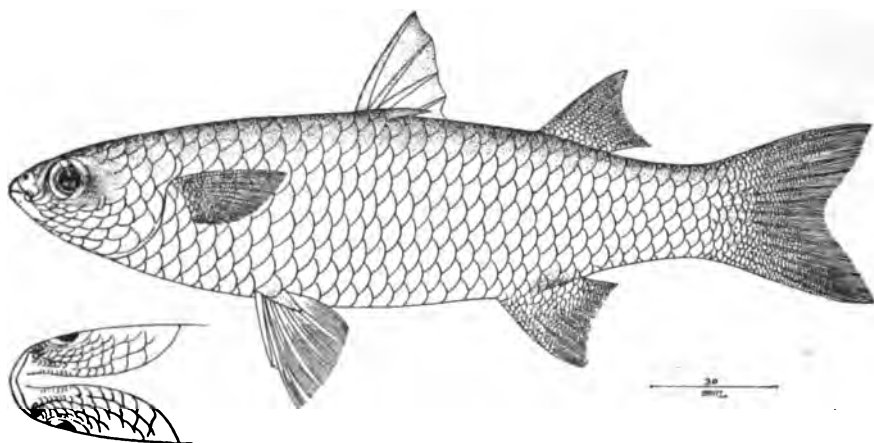


Fig. 4.—*Mugil lepidopterus* sp. nov.

upper jaw width about half of pupil. Inner buccal folds rather narrow. Tongue small, tip free, elongate. Maxillary exposed, reaches eye. Lower preorbital edge slightly convex and finely denticulate. Front nostril about last  $\frac{2}{3}$  in snout, simple pore with slight cutaneous rim. Hind nostril short vertical slit, over and little nearer front nostril than eye. Interorbital broadly and slightly convex, depressed medially.

Gill-opening forward nearly opposite front pupil rim. Rakers about 30+48, slender or finely lanceolate, 3 in filaments and latter about equal eye. Pseudobranchiæ about half of gill-filaments. Isthmus narrowly constricted, with median groove forward.

Scales large, in even longitudinal series, mostly uniform. Head scaly, smaller scales below, extend forward on snout though not

quite to its edge. Scaly pointed flap along spinous dorsal base  $1\frac{1}{2}$  in fin. Short scaly axillary pectoral flap 4 in fin. Axillary scaly ventral flap  $2\frac{1}{2}$  in fin. Broad scaly flap between ventral bases (damaged). Soft dorsal, anal and caudal all densely scaled, only hind edge of last naked. Pectoral and ventral largely scaly over basal portions. Three scales between dorsal spine tips and soft dorsal origin.

Spinous dorsal midway between snout tip and caudal base, first and second spines subequal, fin  $1\frac{1}{2}$  to soft dorsal origin. Latter nearly midway between spinous dorsal origin and caudal base, depressed fin  $1\frac{1}{2}$  to caudal base. Anal origin much nearer caudal base than ventral origin, depressed fin  $1\frac{1}{2}$  to caudal base. Caudal well emarginate behind, about long as head, lobes about equal. Pectoral short, broad,  $1\frac{1}{2}$  to spinous dorsal origin. Ventral inserted about opposite last fourth in pectoral, extends slightly over half way to anal. Vent a scale width before anal.

Color in alcohol faded, dull, uniform brown, slightly olive above. Dorsals slightly dusky above, and same tint very slight along hind caudal edge. Iris dull slaty. Peritoneum black. No dark blotch at shoulder or pectoral base.

Length 206 mm.

Type, No. 47,483, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species is allied with *Mugil dussumieri* Valenciennes<sup>4</sup> in its densely scaled soft dorsal and anal fins. As described by Day<sup>5</sup> *M. dussumieri* would differ in the bent and emarginate preorbital, spinous dorsal origin midway between front eye edge and caudal base, and first spine longest and strongest. Day's fish is also slightly more slender than my example.

(*Δεπίς*, scale; *πτερόν*, fin; with reference to the scaly rayed vertical fins.)

*Corythoichthys matterni* sp. nov. Fig. 5.

Head  $3\frac{1}{2}$  to vent; depth  $7\frac{1}{2}$ ; D. 25; A. 2; P. 15; C. 6; rings 15+39; snout  $2\frac{1}{2}$  in head; eye  $5\frac{1}{2}$ ; pectoral  $5\frac{1}{2}$ ; caudal  $1\frac{1}{2}$  in snout; inter-orbital  $2\frac{1}{2}$  in eye.

Body very long, trunk well compressed and deepest midway in its length, and combined with head  $1\frac{9}{10}$  in long slender tapering tail. Upper keel each side on back not extending beyond last fourth of

<sup>4</sup> Hist. Nat. Poiss., XI, 1836, p. 109. Bombay, Coromandel.

<sup>5</sup> Fishes of India, II, 1876, p. 352 (non Pl. 74, fig. 4).



dorsal. This replaced by similar parallel keel beginning little below opposite dorsal origin and continued to end of tail. Median lateral keel from pectoral axil, slopes down behind close to lower body keel, and ends opposite beginning of hind section of upper keel along back. Median keel on belly complete from breast to vent. Lower keel along each side of body from head to caudal base, and not interrupted.

Head short, compressed, and upper profile concave. Snout little longer than postocular region, profile concave. Eye circular, rather small, supraorbital keel moderate. Mouth terminally superior, small. Maxillary short, about half of eye. Interorbital concave. Opercle with well-developed horizontal keel, and fine striæ radiate above and below. Slight median keel on snout above occiput, and then continued back obsoletely to dorsal, each one being broken at segment junctures.

Gill-opening small superior oblique slit about its own length above pectoral origin,  $1\frac{1}{2}$  in eye.



Fig. 5.—*Corythoichthys malleri* sp. nov.

Rings all firm, and keels without spines. Each ring with numerous transverse striæ.

Dorsal origin slightly behind vent and beginning of second section of upper lateral keel, and extends over 6 abdominal rings. Anal very small, about long as pupil, insertion near last third of ring before dorsal origin. Caudal small, oblong, median rays longest. Pectoral broad basally, long as eye.

Color faded dull brownish in alcohol, ground-color uniform, speckled and finely dotted minutely and irregularly with deeper or darker brown to burnt umber. Side of head with brownish dots and bars, especially on opercle below. Eye crossed by several deep brown radiating bars. Broad deep brown streak from eye along side of snout. From behind each eye obliquely down below deep brown bar, but not united on lower surface of head. Fins all plain and unmarked. Iris pale slaty.

Length 138 mm.

Type, No. 47,484, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species differs from the preceding chiefly in its greatly elongated tail and shorter snout. Of the various synonyms located with *C. spicifer* some approach the present species. Perhaps *Syngnathus biserialis* Kaup<sup>6</sup> is closer, it having D. 26 or 27, rings 16+46 and a much shorter tail. The Indian *Microphis tenuis* Blyth<sup>7</sup> is equally with long tail as my example, snout half the head, D. 24? and rings 16+36.

(For Mr. Edwin S. Mattern of Allentown, Pa., who collected many local fishes for the Academy.)

*Doryichthys philippinus* sp. nov. Fig. 6.

Head  $3\frac{1}{6}$  to vent; depth  $14\frac{1}{2}$ ; D. 40; A. 5; P. 21; C. 5; rings 21+24; snout  $1\frac{1}{2}$  in head; eye  $8\frac{1}{2}$ ; pectoral  $8\frac{1}{2}$ ; caudal  $5\frac{1}{2}$ ; interorbital  $1\frac{1}{2}$  in eye.

Body very long, especially greatly elongated trunk which broad as deep, and deepest midway in its length, tail  $1\frac{1}{2}$  in combined head and trunk. Tail tapers moderately, and not especially slender at caudal base. Upper keel along each side of back to about last

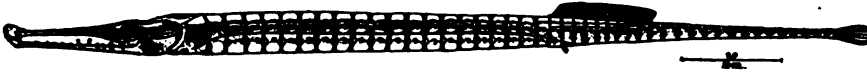


Fig. 6.—*Doryichthys philippinus* sp. nov.

fifth of dorsal. This replaced by similar parallel keel beginning little below about opposite dorsal origin and continued to end of tail. Median lateral keel from pectoral axil, slopes down to lower body edge extent of first three keels along dorsal base and continuous then to caudal base. Median keel on belly complete from breast to vent. Lower keel along each side of body from head to vent, when slightly approximate over first two abdominal keels, then give place to lateral keels.

Head elongate, well compressed, and profiles largely alike. Snout little over twice length of postocular region, profile sloping up behind. Eye circular, moderate, center at last third in head. Mouth terminally superior, small. Maxillary short, about  $1\frac{1}{2}$  in eye, expansion equals pupil. Interorbital slightly concave. Well-developed median keel along snout edge above and one each side which extend to middle of interorbital. Occiput and first 2 rings with median keel. Opercle with well-developed horizontal keel, and from its front end 4 less distinct keels radiate obliquely down and back. Opercle and side of rostrum with fine flutings, reticulate and variable.

<sup>6</sup> Cat. Lophobr. Fish., 1856, p. 33.

<sup>7</sup> Journ. Asiat. Soc. Bengal, 1858, p. 272.

Gill-opening small, horizontal, well elevated and little before pectoral origin, about long as pupil.

Rings all firm, and keels each minutely serrate, each ending in slight spine at sutures. Surface of each keel with many fine vertical striæ.

Dorsal origin about opposite vent or about opposite beginning of second section of upper lateral keel, and base extends over 9 abdominal rings. Anal small, length about half of eye, and its insertion on first abdominal ring slightly behind dorsal origin. Caudal small, oblong, median ray longest. Pectoral very broad basally, so its base equals eye-diameter, and length slightly less than its base.

Color in alcohol rather dull brown generally, sides and belly minutely dusted or speckled with dark brownish. Fom side of snout end to eye deep brown streak, then this as well defined dark brown line over postocular region, on side of back to caudal. Also on sides below this dark line various dusky mottlings, most distinct on trunk rings. Iris pale slaty. Fins largely colorless.

Length 173 mm.

Type, No. 47,485, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Allied with *Microphis pleurostictus* Peters, *M. caudatus* Peters and *M. jagorii* Peters, all from the Philippines, but differs at once in the much longer snout.

**Scomberoides tala** (Cuvier).

Five examples. *Eleira* Jordan and Seale, based on the present species, does not appear really of generic rank. It is characterized by the diverging front canine each side of the lower jaw tip. My examples show this most pronounced in the young, and the teeth gradually erect and inconspicuous with age. Young also without black apical dorsal blotch. *S. moadetta* has enlarged front canines, besides the black apical dorsal blotch.

**SELAR** Bleeker.

*Selar* Bleeker, Nat. Tijds. Ned. Indie, I, 1850, pp. 343, 352, 353. Type *Caranx boops* Cuvier, first species.

*Trachurops* Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 431. Type *Scomber crumenophthalmus* Bloch, monotypic.

The type of *Selar* has not been formally designated, so the above may be adopted. *Trachurops* is thus superseded, as its type species like that of *Selar*, has a deep cross-furrow at the shoulder-girdle at

its juncture with the isthmus, also a small fleshy knob above the furrow.

Jordan and Starks recently contend<sup>8</sup> the use of *Selar* for the *Caranx kalla*, *C. ire* and *C. affinis* group.

*Selar boops* (Cuvier).

Four adults.

*Selar crumenophthalmus* (Bloch).

Several examples.

*Leiognathus philippinus* sp. nov. Fig. 7.

Head 3; depth  $2\frac{1}{2}$ ; D. III, 16; A. III, 14; P. II, 15; V. I, 5; tubes 55 in lateral line to caudal base; about 13 scales in vertical series between spinous dorsal origin and lateral line; about 20? scales in

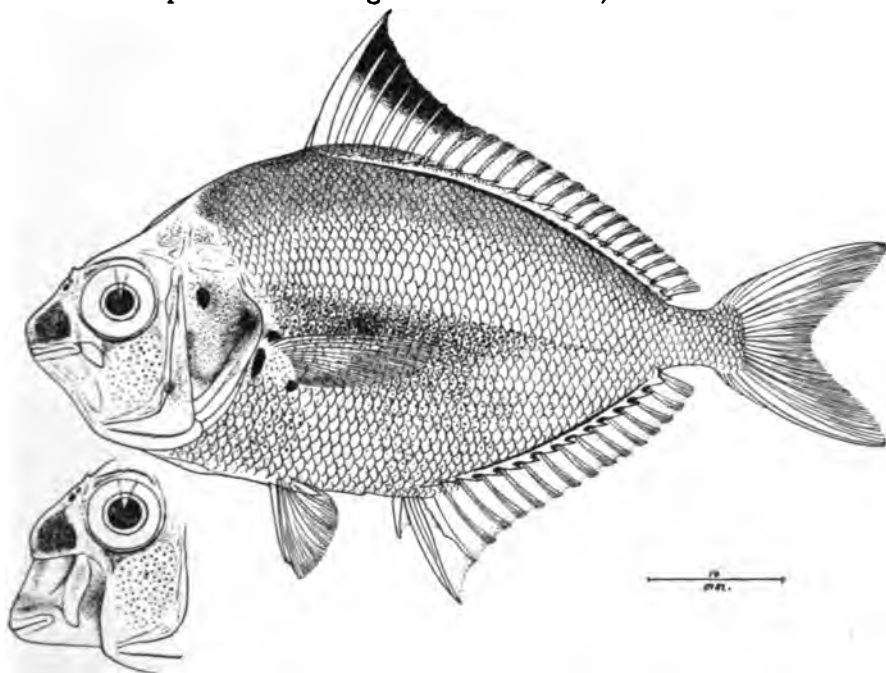


Fig. 7.—*Leiognathus philippinus* sp. nov.

vertical series between spinous anal origin and lateral line; head width  $1\frac{1}{2}$  its length; head depth at occiput 1; second dorsal spine  $1\frac{1}{2}$ ; first dorsal ray 3; second anal spine  $1\frac{1}{2}$ ; first anal ray  $2\frac{1}{2}$ ; upper caudal lobe  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral 2; snout  $3\frac{1}{2}$ ; eye  $2\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{2}$ ; least depth of caudal peduncle  $4\frac{1}{2}$ .

<sup>8</sup> Ann. Carnegie Mus., XI, 1917, p. 443.

Body rather elongate, compressed, deepest near middle or origin of spinous anal, and upper profile little more convex anteriorly than lower. Caudal peduncle compressed, least depth  $1\frac{1}{2}$  its length.

Head rather deep, compressed, profiles similarly inclined. Snout obtuse, convex over surface, protrudes little beyond lower jaw, long as wide. Eye large, close to upper profile, hind pupil edge midway in head length. Mouth small, with short gape horizontal about half way to eye. Lips thin, narrow. Profile of mandible slightly concave to articulation below, which about opposite front pupil edge. Mouth protractile downward. Teeth fine, small, weak, uniform, brush-like, single row in each jaw. No teeth on mouth roof or tongue. Inner buccal folds rather narrow. Tongue thick fleshy, not distinct. Maxillary hangs down from preorbital about  $\frac{2}{3}$  eye-diameter below eye, its expansion 3 in eye. Nostrils together, close before eye about level with upper pupil edge. Interorbital concave. Two short sharp-pointed spines above nostrils. Supraocular ridge finely serrated. Lower preopercle edge well serrated, and serræ largest behind, hind edge entire. Supraocular spine almost meets that of predorsal process.

Gill-opening extends forward about opposite hind pupil edge. Rakers 6+19, lanceolate, trifle less than filaments, which about  $2\frac{1}{2}$  in eye. Pseudobranchiæ little longer than gill-filaments. Shoulder-girdle edge within gill-opening with 2 firm low processes, upper trifle above and lower trifle below, pectoral base. Isthmus width  $2\frac{1}{2}$  in eye, membranes broadly joined.

Scales small, narrowly imbricated, caducous, and extend forward on chest. Well-developed scaly sheaths along bases of spinous dorsal and anal. Soft dorsal and anal with a series of inconspicuous spines each side basally, fin ray between each pair, and all directed evenly backward. Axillary scaly ventral flap  $\frac{1}{2}$  length of spine. Caudal base scaly. Abdomen narrowly compressed, lower face of preanal spine with median groove, spine to vent or midway in space between ventral and anal origins. Short median groove on process of chest. Two small keels extend forward from ventral bases, converge slightly in front. Lateral line convex most its course, reaches caudal base, though with scale interrupted here and there behind. Pores in lateral line simple, each well exposed, and form nearly continuous series.

Spinous dorsal inserted slightly behind pectoral origin, second spine longest, and others graduated down behind to uniformly low soft dorsal. Spinous anal inserted trifle nearer caudal base than

snout tip, first spine about 3 in second, and third about  $\frac{1}{2}$ . Soft anal like soft dorsal. Caudal well forked, pointed lobes about equal. Pectoral pointed, reaches soft anal origin. Ventral inserted below pectoral origin, fin  $\frac{1}{2}$  to anal and spine  $\frac{1}{2}$  of fin. Front basal edges of third dorsal and anal spines finely serrated.

Color in alcohol largely pale brownish. Pale diffuse streak from shoulder to caudal base. Below this and on sides of head many dusky dots, crowded at first but becoming sparse below. Along back, close to dorsal base, dusky line. Along anal basally dusky blotch between each basal spine. Near hind opercle edge blackish short line above and another below. Also shorter bar or blotch above pectoral base and another below, axil with dark brown dots. Opercle shaded dusky, also inside of gill-opening. Chest and cheek with dusky dots like on trunk below. Side of snout dusky-brown. Iris slaty-gray. Black blotch on outer portions of second to fifth spinous dorsal membranes.

Length 65 mm.

Type, No. 47,486, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,487 to 47,490, same data, paratypes. These show: Head  $3\frac{1}{2}$  to  $3\frac{1}{4}$ ; depth  $2\frac{1}{2}$ ; D. VIII, 16; A. III, 13 or 14; snout  $3\frac{1}{2}$  to  $3\frac{1}{4}$  in head; eye  $2\frac{1}{2}$  to 3; maxillary  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; interorbital  $2\frac{1}{2}$  to  $3\frac{1}{2}$ ; length 63 to 68 mm.

Easily distinguished from *L. splendens* by its colors. Falls within *Eubleekeria*.

AURIGEUULA subgen. nov.

Type *Clupea fasciata* Lacépède.

Breast and lower part of belly naked. Lateral line complete. Second dorsal spine twice or more length of third, conspicuously produced. Second anal spine also elongate.

Characterized chiefly by its elongated second dorsal and anal spines.

(*Auriga*, coachman; *Equula* an old name for *Leiognathus*; with reference to the long whip-like dorsal and anal spines.)

*Leiognathus fasciatus* (Lacépède).

One example.

*Amia melas* sp. nov. Fig. 8.

Head  $2\frac{1}{2}$ ; depth  $2\frac{1}{2}$ ; D. VII-I, 9; A. II, 8; P. II, 12; V. I, 5; scales about 21? (according to pockets) in median lateral series from

shoulder to caudal base and possibly 4 more on latter; apparently 2 ? scales above l.l. to spinous dorsal origin and 6? in vertical series below to spinous anal origin; 3 predorsal scales; head width  $2\frac{1}{2}$  in its length; head depth at occiput  $1\frac{1}{2}$ ; mandible  $1\frac{1}{2}$ ; fourth dorsal spine 2; second anal spine 2; second dorsal ray  $1\frac{1}{2}$ ; fourth anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ ; snout  $3\frac{1}{2}$  in head measured from upper jaw tip; eye  $2\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{2}$ .

Body well compressed, deep, back moderately elevated, deepest at spinous dorsal origin, slight median predorsal keel and other

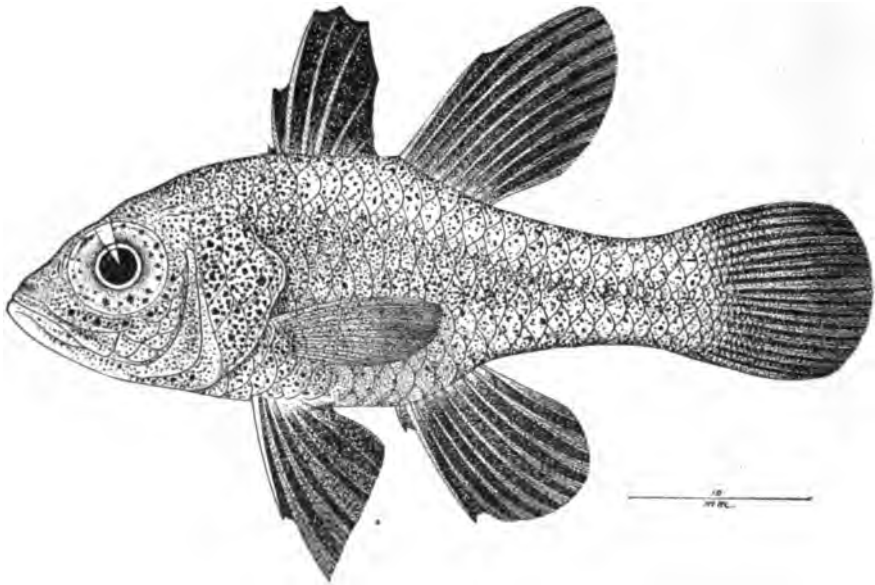


Fig. 8.—*Amia melas* sp. nov.

edges rounded convexly. Caudal peduncle well compressed, least depth about  $1\frac{1}{2}$  its length.

Head large, deep, well compressed, flattened sides nearly evenly sloping above and below, and upper profile little more steep than lower. Snout short, surface convex, though profile little concave, and length  $\frac{2}{3}$  its width. Eye very large, rounded, impinging on upper profile slightly, and center in head length near hind pupil edge. Mouth large, oblique, and closed lower jaw slightly protruding. Maxillary large, oblique, entirely along upper edge slipping below narrow preorbital, and reaches to pupil center. Terminal maxillary expansion  $2\frac{1}{2}$  in eye, hind edge little emarginate. Preorbital width

about 4 in eye. Lips little developed, narrow, firm. Teeth fine, even, short, in moderately wide bands in jaws. Narrow band of similar teeth over vomer to each palatine. Tongue free, depressed, smooth, rounded in front. Front nostril simple pore nearly midway in snout length and hind nostril little larger, close before front eye edge. Interorbital with slight furrow each side in front, slightly convex behind. Preopercle ridge entire, and hind edge minutely serrate. Opercle with 2 small spines along hind edge.

Gill-opening extends forward about opposite front pupil edge. Rakers iv, 1+10, iv, lanceolate, slender, twice length of filaments or 2 in eye. Pseudobranchiæ long as gill-filaments. Isthmus long, constricted forwards, and with deep trenchant keel over greater portion anteriorly.

Scales large, at present mostly fallen, finely ctenoid, and apparently in lengthwise rows. Head scaly, and evidently 2 rows of large scales on cheek. Occiput with number of mucous channels. Apparently scaly flap between ventral bases. At present no axillary ventral scale. Caudal base scaly, otherwise fins naked. Lateral line apparently complete, and largely concurrent with dorsal profile. Tubes? Suprascapula entire.

Spinous dorsal inserted about opposite pectoral origin, fourth spine longest though little longer than third or fifth, second and sixth subequal, and first much shorter than seventh. Soft dorsal inserted about midway between eye centre and caudal base, second ray highest, and depressed fin  $1\frac{1}{2}$  to caudal base. Spinous anal inserted opposite soft dorsal origin, first spine about 5 in second. Soft anal like soft dorsal, though much lower,  $1\frac{1}{2}$  to caudal base. Caudal (damaged) apparently rounded. Pectoral moderate, reaches about opposite last basal fourth of soft dorsal. Ventral origin slightly before pectoral origin, fin reaches soft anal origin and ventral spine but little short of spinous anal origin. Vent about opposite last seventh of depressed ventral spine.

Color in alcohol rather dark chocolate-brown generally, pockets of fallen scales deeper brownish. Except pectorals all fins blackish-brown, very dark and without spots or markings. Pectoral pale brown. Muzzle and mandible slightly paler than rest of head. Iris dull slaty.

Length 55 mm.

Type, No. 47,491, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.



Allied with *Apogon nigricans* Day,<sup>9</sup> but differs in the much lower anal, pectoral with pale base, and apparently without traces of the dark vertical bars.

(Μηλας, black.)

*Amia sealei* sp. nov. Fig. 9.

Head  $2\frac{1}{2}$ ; depth  $2\frac{1}{4}$ ; D. VII-I, 9; A. II, 8; P. II, 12; V. I, 5; scales 22 in lateral line to caudal base and 4 more on latter; 2 scales above l.l. to spinous dorsal origin, and 6 in vertical series below to spinous anal origin; 4 predorsal scales; head width  $2\frac{1}{2}$  in its length; head depth at occiput  $1\frac{1}{2}$ ; snout  $4\frac{1}{2}$ ; eye  $2\frac{1}{8}$ ; maxillary  $2\frac{1}{8}$ ; interorbital 5; third dorsal spine  $2\frac{1}{8}$ ; second anal spine 3; second dorsal ray  $1\frac{1}{8}$ ;

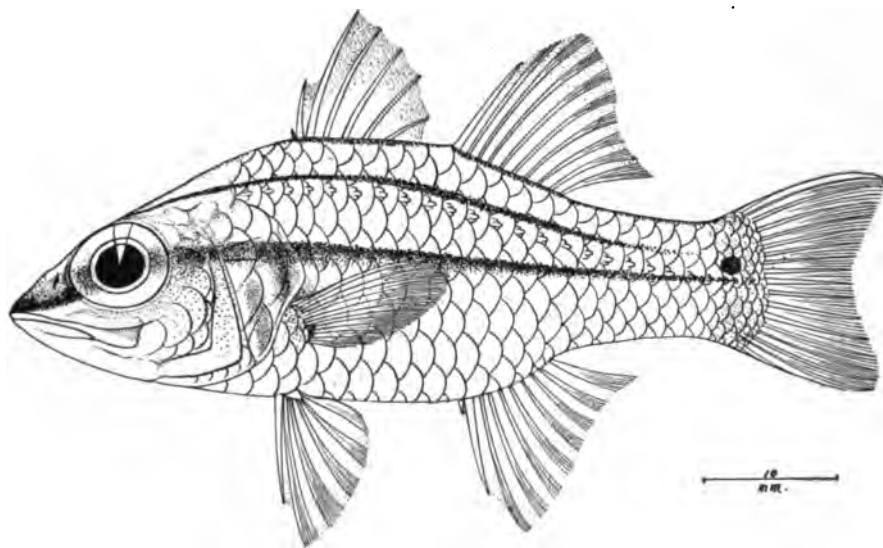


Fig. 9.—*Amia sealei* sp. nov.

first anal ray  $2\frac{1}{8}$ ; least depth of caudal peduncle  $2\frac{1}{4}$ ; caudal (damaged) about  $1\frac{1}{2}$ ?; pectoral  $1\frac{1}{8}$ ; ventral 2.

Body well compressed, rather deep, back not elevated, deepest at spinous dorsal origin, and edges rounded convexly, though slight median predorsal keel. Caudal peduncle well compressed, least depth about  $1\frac{1}{2}$  its length.

Head large, moderately long, compressed, flattened surfaces nearly evenly sloping above and below, upper profile much more inclined than lower, and rather convex. Snout short, surface convex,

<sup>9</sup> Fishes of India, I, 1875, p. 58, Pl. 16, fig. 3. Madras.

also profile, length about  $\frac{3}{4}$  its width. Eye large, circular, impinging slightly on upper profile, and head center in length midway between hind pupil and hind eye edges. Mouth moderately large, scarcely inclined from horizontal, and closed lower jaw included within upper. Maxillary large, little inclined, nearly straight, and reaches past eye center nearly opposite hind pupil edge. Terminal maxillary expansion 3 in eye, little emarginate behind, and whole upper maxillary edge slips below preorbital. Preorbital rather narrow, width about 4 in eye. Lips rather narrow, fleshy, firm. Teeth fine, even, short, in narrow bands in jaws. Also similar narrow band over vomer to and on each palatine. Tongue free, depressed, smooth, rather rounded in front. Front nostril lateral on snout, slightly nearer snout tip than eye, in short tube. Hind nostril short vertical slit close before front eye edge. Interorbital with slight furrow each side in front, slightly convex behind. Preopercle ridge entire, and hind edge minutely serrate. Opercle with small spine above and smaller one median on hind edge.

Gill-opening about opposite front pupil edge. Rakers II, 3+12, IV, lanceolate, rather robust, about  $\frac{1}{2}$  of filaments and latter 3 in eye. Pseudobranchiæ large as filaments. Isthmus long, constricted forward, and with median trenchant keel anteriorly.

Scales large, finely ctenoid, above lateral line in rows parallel with its course, and below in horizontal rows. Head scaly, cheek with 2 rows of large scales, though hind row greatly crowded or concealed under front row, and scales on opercles moderate. Suborbitals and upper surface of head with numerous mucous channels. Large scaly flap between ventral bases nearly half length of fin. Axillary ventral scale small and inconspicuous. Caudal base covered with small scales, otherwise fins naked. Lateral line complete, largely concurrent with dorsal profile. Tubes simple, extend well over scales, and with appearance as if located on somewhat small obscure accessory scale.

Spinous dorsal inserted about opposite pectoral origin, third spine longest, second and seventh subequally short, though longer than first. Soft dorsal inserted about midway between caudal base and hind eye edge, second ray apparently highest, and depressed fin  $1\frac{1}{2}$  to caudal base. Spinous anal inserted opposite second dorsal origin, first spine scarcely  $\frac{1}{2}$  of second. Soft anal smaller than soft dorsal, otherwise similar. Depressed anal  $1\frac{1}{2}$  to caudal base. Caudal very slightly emarginate behind, lobes rounded. Pectoral moderate, reaches anal, upper rays longest. Ventral inserted slightly

before pectoral origin, reaches vent or  $\frac{7}{8}$  to anal. Ventral spine  $\frac{2}{3}$  of fin.

Color in alcohol pale brownish generally, slightly paler below. Fins all pale or whitish, except brownish shade on spinous dorsal and scales at caudal base. Latter also with small jet-black round spot, less than half of pupil diameter, just above lateral line. From snout tip narrow blackish-brown line to front of eye and slopes evenly from hind eye edge to caudal base medianly, in straight course, also ends just below black caudal spot. Above this line on snout another given off each side of snout tip, extends up over interorbital then just above lateral line and finally fades out on caudal peduncle above and behind. Pale brown median line from interorbital and borders dorsal bases, continued medially behind to caudal. Opercle with 2 brownish vertical bars. Iris slaty.

Length 66 mm.

Type, No. 47,492, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,493 to 47,499, paratypes, same data. These show: Head  $2\frac{2}{3}$  to  $2\frac{1}{2}$ ; depth  $2\frac{1}{4}$  to  $2\frac{1}{2}$ ; D. VII-I, 9, 1, A. II, 8; scales 23 to 26 in lateral line to caudal base and 4 more on latter; snout  $3\frac{1}{2}$  to 4 in head, measured from upper jaw tip, eye  $2\frac{1}{2}$  to 3; maxillary  $2\frac{1}{10}$  to  $2\frac{1}{4}$ ; interorbital  $4\frac{1}{2}$  to  $4\frac{1}{4}$ ; length 63 to 68 mm.

This species appears to differ chiefly in its coloration, especially the narrow lengthwise dark lines and the small black caudal spot above the lateral line, as in *A. exostigma* Jordan and Seale. Though very much narrower, the disposition of these lengthwise dark bands is like those of *A. quadrifascatus* Cuvier.

(For Mr. Alvin Seale, in slight recognition of his work in the Philippine fisheries.)

*Amia wilsoni* sp. nov. Fig. 10.

Head  $2\frac{2}{3}$ ; depth  $2\frac{1}{4}$ ; D. VIII-I, 9, 1; A. II, 8; P. II, 12; A. I, 5; scales 22 in lateral line to caudal base and 3 more on latter; 2 scales above l.l. to spinous dorsal origin, and 6 below to spinous anal origin; about 4 predorsal scales; head width about half its length; head depth  $1\frac{1}{2}$ ; snout 4; eye  $2\frac{1}{4}$ ; maxillary  $2\frac{1}{4}$ ; interorbital  $4\frac{1}{4}$ ; third dorsal spine  $1\frac{1}{8}$ ; first dorsal ray  $1\frac{1}{2}$ ; second anal spine  $2\frac{3}{4}$ ; second anal ray  $2\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{4}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body well compressed, rather deep, back not elevated, deepest at spinous dorsal origin, and edges rounded convexly, though slight median predorsal keel. Caudal peduncle well compressed, least depth about  $1\frac{1}{2}$  its length.

Head large, moderately long, compressed, flattened surfaces nearly evenly sloping above and below, profiles about evenly sloping above and below. Snout short, surface convex, length  $\frac{3}{4}$  its width. Eye large, circular, impinging slightly on upper profile, and center in head length about hind pupil edge. Mouth well inclined, moderately large, and closed lower jaw slightly included within upper. Maxillary large, well inclined, nearly straight, and reaches eye center. Terminal maxillary expansion 3 in eye, little emarginate behind, and whole upper maxillary edge slips below preorbital. Preorbital rather narrow, width about 4 in eye. Lips rather narrow, fleshy,

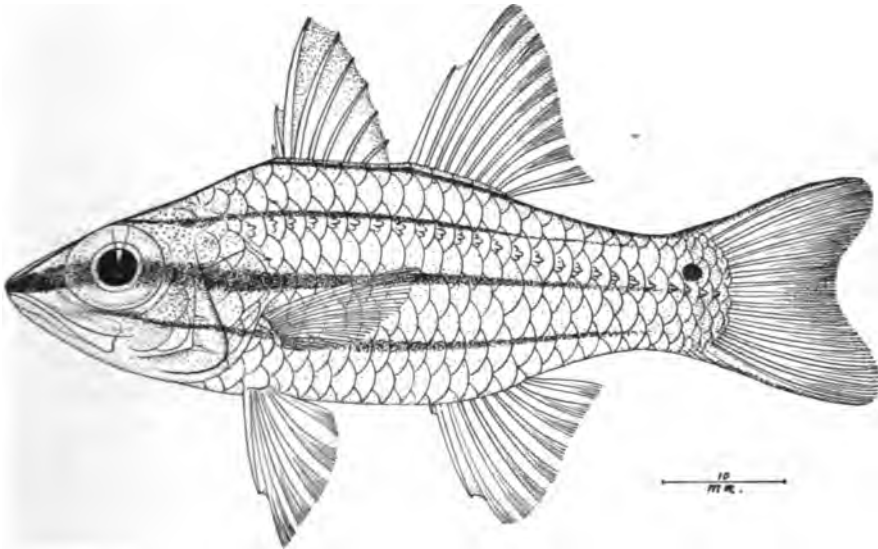


Fig. 10.—*Amia wilsoni* sp. nov.

firm. Teeth fine, even, short, in narrow bands in jaws. Also similar narrow band over vomer to each palatine. Tongue free, depressed, smooth, rather rounded in front. Front nostril lateral on snout, slightly nearer snout tip than eye, in short tube. Hind nostril simple slit at last fourth in snout. Interorbital level. Preopercle ridge entire. Hind and lower preopercle edge finely serrated. Opercle with single small spine.

Gill-opening about opposite front pupil edge. Rakers iv, 3+12; rv, lanceolate, longer than filaments or  $2\frac{3}{4}$  in eye. Pseudobranchiæ little longer than filaments. Isthmus long, constricted forwards and with median trenchant keel.

Scales large, finely ctenoid, above lateral line in rows parallel with

its course, and below in horizontal rows. Head scaly, cheek with 2 rows of large scales, and hind row of but several under front row. Opercles with scales of moderate size. Suborbitals, muzzle, preopercle and upper surface of head with numerous mucous channels marked by great numbers of minute pores. Large scaly flap between bases nearly  $\frac{2}{3}$  fin length. Axillary ventral scale about  $\frac{1}{4}$  of ventral spine. Caudal base covered with small scales, otherwise fins naked. Lateral line complete, largely concurrent with dorsal profile. Tubes simple, extend well over scales, and with appearance as if on somewhat small accessory scale.

Spinous dorsal inserted about opposite pectoral origin, third spine longest, second little shorter than seventh, and first shortest. Soft dorsal inserted about midway between eye center and caudal base, first ray highest and depressed fin  $1\frac{1}{2}$  to caudal base. Spinous anal inserted about opposite soft dorsal origin, first spine scarcely  $\frac{1}{3}$  of second. Soft anal little smaller than soft dorsal, otherwise similar. Depressed anal  $1\frac{1}{2}$  to caudal base. Caudal very slightly emarginate behind, and lobes rounded. Pectoral moderate, reaches nearly to anal, upper rays longest. Ventral inserted well before pectoral origin, reaches beyond vent or about  $\frac{1}{3}$  to anal. Ventral spine  $1\frac{1}{2}$  in fin.

Color in alcohol pale brownish generally, slightly paler below. Fins all pale, except dusky shade on spinous dorsal terminally. Upper and lower caudal edges slightly dusky. Conspicuous blackish-brown blotch on caudal base just above lateral line, in size about half of pupil. From snout tip narrow blackish-brown line to front of eye, and horizontal from hind eye edge to caudal base medially, also obscure just below caudal spot. On snout and behind eye this line wide as pupil, though on side of body narrows until like other lines. Another parallel narrower line extends from lower eye edge to middle of pectoral base and back towards lower portion of caudal peduncle. On each side of snout above narrow line extends up over interorbital close above lateral line, and fades out behind on upper surface of caudal peduncle. Finally narrow median brownish line begins on interorbital and extends to spinous dorsal, borders base of each dorsal fin and then forms single median line again on postdorsal to caudal. Iris slaty.

Length 72 mm.

Type, No. 47,505, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Greatly resembles the preceding species, but differs at once in coloration. Besides the presence of the third lateral line below, the larger caudal spot and wider median lateral band anteriorly, there are no dark bars on the opercle.

(To Dr. William P. Wilson, of the Commercial Museums of Philadelphia, to whom I am indebted for the opportunity to study the present collection.)

*Amia radcliffei* sp. nov. Fig. 11.

Head  $2\frac{2}{3}$ ; depth  $2\frac{1}{3}$ ; D. VII-I, 9, 1; A. II, 8, 1; P. II, 10; V. I, 5; scales 23 in lateral line to caudal base and 4 more on latter; 2 scales between spinous dorsal origin, and lateral line, and 6 scales in vertical

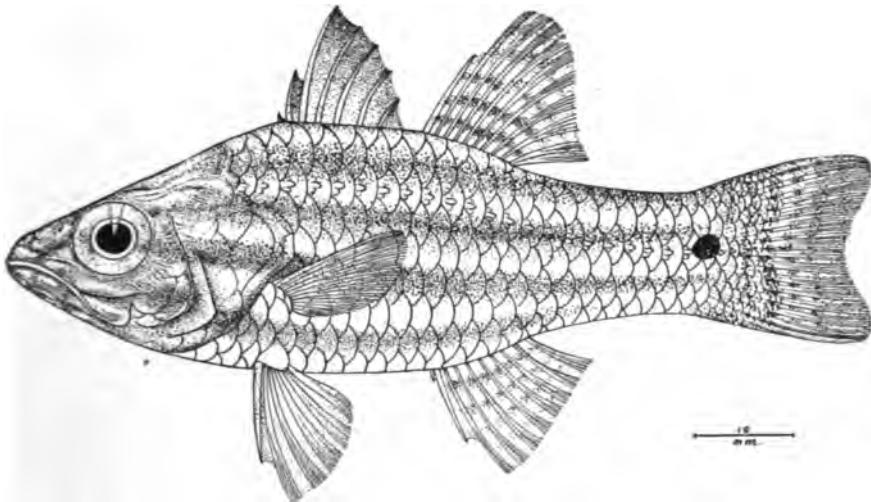


Fig. 11.—*Amia radcliffei* sp. nov.

series to spinous anal origin; 4 predorsal scales; head width 2 in its length; head depth at occiput  $1\frac{1}{3}$ ; snout  $3\frac{2}{3}$ ; eye  $3\frac{2}{3}$ ; maxillary 2; interorbital 5; third dorsal spine  $2\frac{1}{3}$ ; first dorsal ray  $1\frac{1}{3}$ ; second anal spine  $3\frac{1}{3}$ ; second anal ray (damaged)  $2\frac{2}{3}$ ; least depth of caudal peduncle  $2\frac{1}{3}$ ; caudal (damaged) about  $1\frac{1}{3}$ ; pectoral 2; ventral 2.

Body well compressed, moderately deep, back not elevated, deepest at spinous dorsal origin, and edges rounded convexly, predorsal scarcely with median keel. Caudal peduncle well compressed, least depth  $1\frac{1}{3}$  its length.

Head large, moderately long, compressed, flattened surfaces slightly swollen below, profiles nearly straight and similarly inclined. Snout moderate, surface convex, length about  $\frac{3}{4}$  of width. Eye

large, circular, next to upper profile, and head center in length nearly at hind eye edge. Mouth large, rather well inclined, and closed lower jaw included within upper. Maxillary large, well inclined, nearly straight and reaches past eye center about to hind pupil edge. Terminal maxillary expansion 2 in eye, slightly emarginate behind, and whole upper maxillary edge slips below preorbital. Latter moderate, width 3 in eye. Lips moderate, fleshy, firm. Teeth fine, even, short, in moderately wide bands in jaws. Narrow band over vomer to and on each palatine. Tongue free, depressed, smooth, rounded in front. Inner buccal folds rather narrow. Front nostril short inconspicuous tube about midway in snout. Hind nostril moderate pore close before, and nearer eye, than front nostril. Interorbital generally depressed, with slight furrow each side. Preopercle ridge entire, hind edge finely serrate. Opercle with single small spine.

Gill-opening forward about opposite hind nostril. Rakers II, 4+12, II, rather robust, lanceolate, nearly long as filaments, which 3 in eye. Pseudobranchiæ about long as filaments. Isthmus long, constricted forward, and with median keel, especially trenchant forward.

Scales large, finely ctenoid, above lateral line in rows parallel with its course, and below in horizontal rows. Head scaly, cheek with 2 rows, and opercles with moderate scales. Head above and mandible with numerous mucous channels. Large scaly flap between ventral bases about  $\frac{2}{3}$  length of fin. Axillary ventral scale moderate, rounded. Caudal base covered with small scales, fins otherwise naked. Lateral line complete, largely concurrent with dorsal profile. Tubes simple, extend well over scales, large, and with appearance as if located on small obscure accessory scale.

Spinous dorsal inserted slightly behind pectoral origin, or about midway between snout tip and middle of last depressed dorsal ray, all spines slightly curved, third longest, second little longer than seventh, and first very short. Soft dorsal inserted nearly midway between hind eye edge and caudal base, spine  $\frac{2}{3}$  of fin, and depressed fin  $1\frac{1}{2}$  to caudal base. Spinous anal origin about opposite that of soft dorsal, and with soft anal much smaller than soft dorsal, though reaches about as far posteriorly. First anal spine about  $\frac{1}{2}$  length of second. Caudal broad, slightly emarginate behind, and lobes rounded. Pectoral broad, not quite to anal origin. Ventral inserted well before pectoral origin, fin depressed  $\frac{3}{4}$  to anal origin, spine about  $\frac{2}{3}$  in fin. Vent little nearer depressed ventral tip than anal origin.

Color in alcohol dull brownish, more or less with general dull sooty tint, below well as above. Four obscure dark longitudinal bands, broad at first and narrow behind. First on back above lateral line, then along upper edge of caudal peduncle. Second from shoulder just below lateral line, and crosses latter below hind portion of soft dorsal. Third as band on snout tip, behind eye and crosses opercle back above pectoral to base of lower caudal lobe. Fourth obscurely along lower edge of abdomen. Caudal base with round jet-black spot about size of pupil, slightly above middle. Muzzle sooty-brown. Iris slaty. Fins all pale, outer portion of spinous dorsal brownish, and soft dorsal, anal and caudal all with 3 or 4 rows of small brown spots transversely. Gill-opening edge below broadly dusted dusky-brown, also lower surfaces of ventrals.

Length 90 mm. (caudal damaged).

Type, No. 47,500, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,501 to 47,504, A. N. S. P., paratypes, same data. They show: Head  $2\frac{2}{3}$  to  $2\frac{1}{2}$ ; depth  $2\frac{1}{4}$  to 3; D. VII-I, 9, 1, and one VII-I, 10, 1; A. II, 8, 1; scales 22 to 24 in l.l. to caudal base and 4 or 5 more on latter; snout  $3\frac{2}{3}$  to 4 in head; eye 3 to  $3\frac{1}{2}$ ; maxillary 2; interorbital 5 to  $5\frac{1}{2}$ ; length 75 to 90 mm.

Allied with *Amia hartzfeldi* Bleeker,<sup>10</sup> but that species is figured by its author with the dark caudal spot median basally, and but one blackish bar sub-basally on soft dorsal and anal, also scales on cheek in 4 rows, and maxillary longer.

(For Mr. Louis Radcliffe, of the Bureau of Fisheries at Washington, who studied the cardinal fishes of the Philippines.)

*Amia savayensis* (Günther).

A large series of this very variable species, 40 to 73 mm. in length. Sixteen agree with Günther's figure in most cases, but as they have long been in formaline the color-pattern has largely faded. In some the dark vertical stripes are very narrow, as the dark bands in all are margined each side with a still darker tint, and all the intervening color fading leaves them increased from the original eight to twice that number. The broad dark band on the caudal peduncle is present only as a saddle above. Every one of these examples have the oblique dark streak from the lower corner of the eye across the cheek. Upon comparison with eight specimens from Apia,

<sup>10</sup> Atlas Ich. Ind. Néerl., VIII, 1876-7, Pl. 69, fig. 2.



Samoa, all smaller, the dark streak from the eye to the preopercle angle is narrow, not quite so wedge-shaped as in the Manila examples. Also some show the dark saddle on the caudal peduncle simply as a dark blotch above the lateral line.

The rest of the series embraces 115 examples; all seem to agree in the dull unicolored caudal. They show underlaid traces of the three vertical broad dark bands of *A. bandanensis*, but only one on the caudal peduncle distinct, while others give place to about six vertical and rather broad bands in the space between the head and last dorsal ray's base.

*Apogon savayensis* Day<sup>11</sup> may represent a species distinct from the present one, as it is described and figured with the hind caudal edge dusky. It also has three broad dark vertical bands, one from each dorsal and the other a saddle on the caudal peduncle above. It surely approaches more closely Bleeker's *A. bandanensis*, which is figured with a uniform caudal.

*A. nubilus* Garman<sup>12</sup> is closer to my larger lot of specimens grouped above under the present species, but differs in the dark bar on the caudal basally, the dark broad vertical underlaid shades on the body below the dorsal fins, and the caudal peduncle blotch complete. Jordan and Seale say it is apparently the young of *Amia savayensis* with the markings faded.

***Archamia zosterophora* (Bleeker). Fig. 12.**

Head  $2\frac{3}{4}$ ; depth  $2\frac{3}{4}$ ; D. VI-I, 9, 1; A. II, 15; P. II, 12; V. I, 5; scales (pockets) 20 in lateral line to caudal base and 4? more on latter; 2 scales (pockets) above l.l. to spinous dorsal origin, and about 6 below in vertical series to spinous anal origin; 6 predorsal scales; head width  $2\frac{1}{2}$  its length; head depth  $1\frac{1}{2}$ ; mandible  $1\frac{1}{2}$ ; third dorsal spine  $2\frac{3}{4}$ ; second dorsal ray  $1\frac{1}{2}$ ; second anal spine  $2\frac{3}{4}$ ; first branched anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{4}$ ; upper caudal lobe  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $2\frac{1}{2}$ ; snout  $4\frac{1}{2}$  in head measured from upper jaw tip; eye  $2\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{4}$ .

Body well compressed, contour rather elongately ovoid with greatest depth at dorsal origin, and edges all convexly rounded. Caudal peduncle well compressed, least depth  $1\frac{1}{2}$  its length.

Head deep, well compressed, flattened sides slightly approximated below, and lower profile very much more steep and convex than upper. Snout convex over surface, length about half its width. Eye large, close to upper profile, rounded, and hind edge about

<sup>11</sup> Fishes of India, I, 1875, p. 60, Pl. 16, fig. 5.

<sup>12</sup> Bull. Mus. Comp. Zool., 39, 1903, p. 230, Pl. 1, fig. 1. Suva, Fiji.

midway in head length. Mouth large, well inclined, mandible slightly protruding in front. Maxillary well inclined, straight, reaches opposite last fourth in pupil, and terminal expansion about  $2\frac{1}{2}$  in eye, its hind edge slightly emarginate. Upper maxillary edge slips below preorbital except very short part of hind edge. Teeth minute, in narrow bands in jaws and apparently absent from mouth roof. Lips narrow, little fleshy. Tongue free, smooth, depressed, rather narrowly triangular. Inner buccal folds narrow. Front nostril small pore about first third in snout, and hind nostril short slit very close to front eye edge. Interorbital nearly level. Sub-

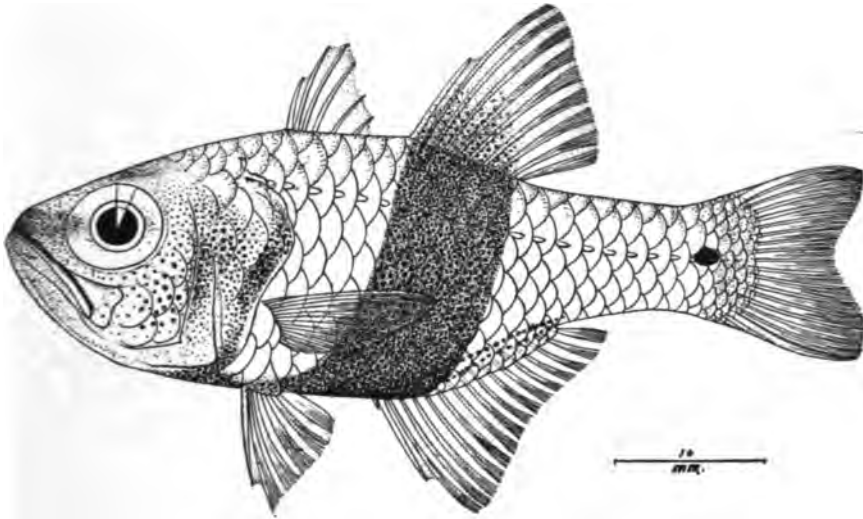


Fig. 12.—*Archamia zosterophora* (Bleeker).

orbital width about half of pupil. Preopercle ridge entire, with broad short spine at angle, and hind edge finely denticulate. Opercle without spine.

Gill-opening forward opposite front eye edge. Rakers 6+14, lanceolate, twice length of filaments or 2 in eye. Pseudobranchiæ long as gill-filaments. Isthmus narrowly compressed, slightly attenuated forwards, with trenchant edge, especially anteriorly.

Scales caducous, large, narrowly imbricated, in longitudinal series, minutely ctenoid. Scales in 2 rows on cheek, and scales on opercles moderate. Axillary ventral scale moderate, broad, pointed, about  $\frac{2}{3}$  length of spine. Caudal base scaly, also anal base. Lateral line complete, concurrent with dorsal profile. Tubes large, trifid, well exposed. Bones of head rather cavernous. Suprascapula edge jagged.

Spinous dorsal origin little behind that of pectoral, fin low and spines weak, or slender, third longest with second and fourth subequal, depressed fin not quite reaching soft dorsal. Latter inserted about midway between eye center and caudal base, spine about half fin length, which depressed extends  $\frac{2}{3}$  to caudal base. Anal inserted well before soft dorsal origin or about midway between front eye edge and caudal base, first branched ray longest though second subequal, and when depressed neither reach last dorsal ray base. Caudal emarginate, lobes rounded. Pectoral broad, reaches about first third in anal base. Ventral inserted before pectoral origin, reaches anal, and spine  $\frac{2}{3}$  of fin. Vent close before anal.

Color in alcohol very pale or light brownish generally, scales on back above obscurely and finely dusted with slightly darker brownish. On postocular, cheek and suborbital a number of dull brown dots, some enlarged slightly. Blackish-brown band from snout tip to eye. On shoulder-girdle behind gill-opening, blackish brown streak forward to breast which same color. This also extends back over belly below, rising up obliquely after ventral bases to second dorsal fin as broad dark band, in width about equal to  $1\frac{1}{2}$  eye-diameters. It is also reflected out on soft dorsal basally, but not the anal. All dark area noted made up of large crowded dark specks, larger and more sparse below. At caudal base round jet-black spot, median, and less than half of pupil in diameter. Fins, except coloration of soft dorsal and caudal base as noted, all uniform pale or brownish-white.

Length 58 mm.

Twelve examples from the Philippine Islands. Presented by the Commercial Museums of Philadelphia. Eleven show: Head  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; depth  $2\frac{1}{4}$  to  $2\frac{3}{4}$ ; D. VI-I, 9, 1; A. II, 15, 1 or 16, 1, rarely 14, 1; scales 19 or 20 in l.l. (pockets) to caudal base; snout 4 to  $4\frac{1}{2}$  in head measured from upper jaw tip; eye  $2\frac{1}{2}$  to 3; maxillary  $1\frac{1}{2}$  to  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{4}$  to 4; length 53 to 63 mm.

I redescribe this species as my material differs somewhat from both the description and figure by Bleeker.<sup>13</sup> This is especially evident in the broad dark band extending forward on the breast, and the black caudal spot not half the pupil diameter. Bleeker's figure does not show the former before the ventral bases and its forward limit is not mentioned in the description. He shows the caudal spot large as the eye. Weber's note<sup>14</sup> does not add sufficient detail to help solve this point.

<sup>13</sup> Atlas Ich. Ind. Néerl., VII, 1873-6, p. 103.

<sup>14</sup> Siboga Exp., Fische, 1913, p. 5.

*Epinephelus matterai* sp. nov. Fig. 13.

Head  $2\frac{3}{4}$ ; depth 3; D. XI, 15, 1; A. III, 8, 1; P. II, 16, 1; V. I, 5; scales 92 in lateral line to caudal base, and about 6 more on latter; tubes in l.l. 52 to caudal base and 5 more on latter; 17 scales in vertical series above l.l. to spinous dorsal origin; 11 scales in vertical series between soft dorsal origin and l.l.; about 27 scales in vertical series between spinous anal origin and l.l.; head width  $1\frac{1}{2}$  its length; head depth at occiput  $1\frac{1}{2}$ ; mandible 2; third dorsal spine  $2\frac{3}{4}$ ; second branched dorsal ray  $2\frac{1}{4}$ ; second anal spine  $2\frac{7}{8}$ ; second branched anal ray  $2\frac{1}{4}$ ; least depth of caudal peduncle  $3\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral 2; snout  $4\frac{1}{4}$  in head measured from upper jaw tip; eye 5; maxillary  $2\frac{1}{2}$ ; interorbital 6.

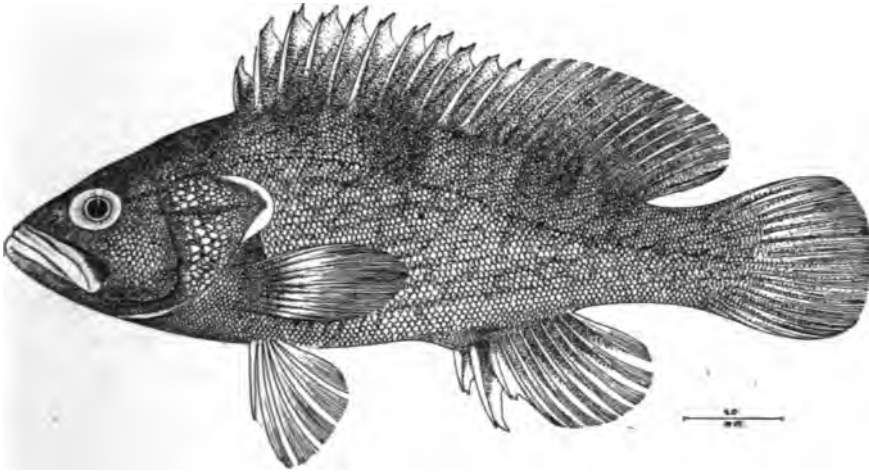


Fig. 13.—*Epinephelus malleri* sp. nov.

Body robust, elongate, compressed, profiles rather evenly convex, though upper little more so, contour slightly ovoid with greatest depth about base of fifth dorsal spine. Body edges rounded convexly, chest and belly broadly so. Caudal peduncle compressed, length about  $\frac{3}{4}$  its least depth.

Head rather large, compressed, greatest width slightly swollen below, profiles similarly inclined and nearly straight. Snout convex over surface, profile obliquely straight, and length about  $\frac{3}{4}$  its width. Eye little longer than deep, rounded, close to upper profile and center near first third in head. Mouth oblique, and broad mandible protruding in front. Lips rather broad, thick or fleshy. Maxillary well exposed, reaches about opposite hind pupil edge, and expansion  $1\frac{1}{2}$  in eye. Bands of rather small fine teeth in jaws, a few canine-like

in front of upper and along rami of mandible posteriorly, where also in but 2 rows on each ramus. Latter but little elevated inside mouth. Bands of much smaller teeth across vomer and on each palatine. Buccal folds moderately broad in mouth. Tongue depressed, smooth, free, and attenuated. Nostrils close together on side of snout, also close before front eye edge, front one with short tube and short cutaneous flap behind. Preorbital narrow,  $2\frac{1}{4}$  in eye. Interorbital slightly convex. Preopercle edge slightly convex behind, finely serrated and with about 5 enlarged denticles around corner. Opercular spines 3, median largest, closer to lower and little posterior.

Gill-opening extending forward opposite front eye edge, and uppermost edge but slightly inclined from horizontal. Rakers iv, 3+9, iv, lanceolate, and longest about equal gill-filaments or  $2\frac{1}{2}$  in eye. Pseudobranchiæ about  $\frac{1}{4}$  of gill-filaments. Isthmus broad, bevelled in front, with slight keel behind.

Scales all finely ctenoid, largest on trunk, smaller along body edges, especially predorsal, breast and belly. Very small scales on head above, with crowded smaller ones basally, these also extend over postocular and suborbital regions, and cheek. Small scales also crowded about upper part of opercular flap. Very small scales over mandible, and about 10 rows on maxillary. Scales on trunk in more or less horizontal rows, crossing lateral line. Minute scales over basal portions of all fins more or less. Pectoral axil with pit, sheathed above by broad flap covered with small scales. Though of irregular size scales on cheek in about 25 rows from eye to lower preopercle angle. Lateral line of simple inclined tubes little exposed, and its course nearly concurrent with dorsal profile, out on caudal base medianly.

Spinous dorsal inserted little nearer snout tip than origin of soft dorsal, spines graduated down from third which longest, edge deeply notched with cutaneous point behind each spine tip. Soft dorsal inserted midway between spinous dorsal origin and caudal base, fin oblong, rounded in front and behind. Spinous anal inserted little nearer ventral origin than caudal base, second spine longest, third but little shorter, and first  $\frac{2}{3}$  of second. Soft anal rounded, also caudal. Pectoral broad, reaches about  $\frac{2}{3}$  to anal, and median rays longest. Ventral inserted close behind pectoral base, depressed fin reaching  $\frac{2}{3}$  to anal, and spine about  $\frac{2}{3}$  fin length. Vent at first third in space between depressed ventral tips and anal origin.

Color in alcohol brownish generally, only paler or much lighter

on extreme lower surface of head, breast and belly. About 5 indistinct deep brown obscure slightly inclined band-like saddles on back, first at predorsal, second on spinous dorsal medially, third just before soft dorsal, fourth at front median region of soft dorsal, and fifth at hind portion of soft dorsal. Whole trunk and head with slightly inclined dark streaks, irregularly and obscurely, slightly wavy, and quite numerous, but not parallel with rows of scales. Also ground-color with many pale blotches, spots or streaks, underlaid and obscure. Head more with speckled or spotted appearance than trunk. Coloration of latter extends on vertical fins more or less basally. Maxillary with brownish streak on scaly area. Fins all with obscure speckled appearance. Iris slaty-gray.

Length 178 mm.

Type, No. 47,506, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species is allied with *E. bontoides* (Bleeker), *E. megachir* (Richardson), *E. diacanthus* (Valenciennes) and *E. maculatus* (Bloch) in its biserial mandibular teeth. It most closely approaches *E. bontoides* in its equidistant opercular spines and mostly ciliated scales. These characters also agree with *E. megachir*, but that species has the pectoral long as its head. From *E. bontoides* it differs at once from any material or accounts I have seen, in color. This has been described as brown above with more or less numerous black dots, which may not be present on the fins.

**RHOMBOPLITOIDES** gen. nov.

Type *Rhomboplitoides megalops* sp. nov.

This genus of *Lutianidae* resembles the American *Rhomboplites* in its scaly soft dorsal and anal fins, but differs in squamation, as the scales above the lateral line in oblique rows and those below in horizontal rows. It falls within the *Lutianinae* in its entire inter-orbital and dentition.

(*Rhomboplites*; *elios*, appearance.)

*Rhomboplitoides megalops* sp. nov. Fig. 14.

Head  $2\frac{1}{2}$ ; depth 3; D. XI, 11, 1; A. III, 8; P. II, 15; V. I, 5; scales 51 in lateral line to caudal base and 7 more on latter; 7 scales above l.l. to spinous dorsal origin, and 14 below in vertical row to spinous anal origin; 25 predorsal scales; head width  $2\frac{1}{6}$  in its length; head depth at occiput  $1\frac{1}{2}$ ; mandible  $2\frac{1}{6}$ ; third dorsal spine  $2\frac{1}{2}$ ; first branched dorsal ray  $3\frac{1}{2}$ ; third anal spine  $2\frac{1}{2}$ ; first branched anal ray  $2\frac{1}{2}$ ; least

depth of caudal peduncle  $3\frac{1}{2}$ ; caudal  $1\frac{3}{4}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ ; snout  $3\frac{3}{4}$  in head measured from upper jaw tip; eye 3; maxillary  $2\frac{3}{4}$ ; interorbital 4.

Body elongate, contour evenly fusiform with greatest depth at fourth dorsal spine base, and edges all convex, or with but slight keel just before dorsal. Caudal peduncle compressed, about long as deep.

Head large, well compressed with flattened sides little approximated below, and profiles evenly and slightly convex. Snout rather conic, convex over surface and slightly so in profile, length about  $\frac{3}{4}$  its width. Eye very large, impinging on upper profile, and hind pupil edge near head center in length. Mouth large, oblique, and

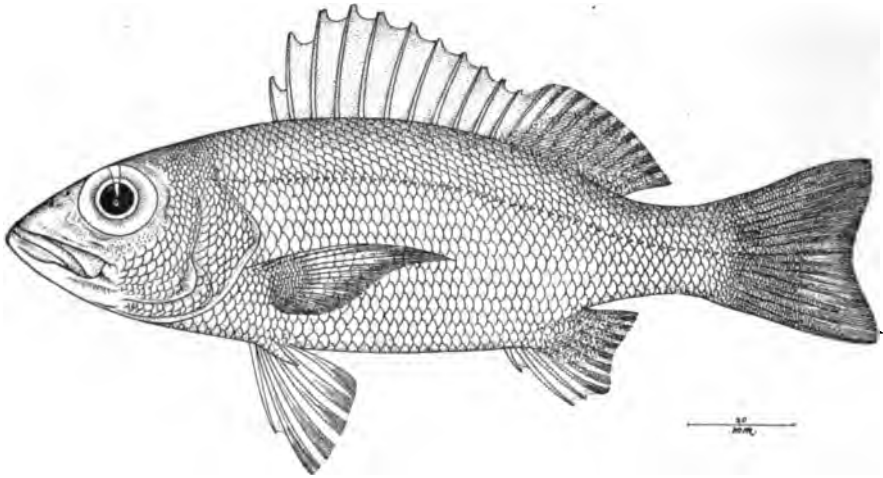


Fig. 14.—*Rhomboplitoides megalops* sp. nov.

gape extends about opposite front nostril. Premaxillaries moderately protractile. Maxillary oblique, upper edge entirely slips below preorbital, reaches first third in eye, and expansion  $2\frac{1}{2}$  in eye. Lips thick, firm, tough, largely conceal teeth, lateral in jaws. Teeth in jaws in narrow bands, villiform, and with outer row of simple enlarged well-spaced canines, only visible in profile in front of upper and side of lower. Vomer with an elongate patch of villiform teeth, in outline similar to a narrow kite. Each palatine with narrow well-developed band of villiform teeth. Mandible rather robust, moderately deep, rami little elevated inside mouth, and symphysis slightly protrudes when closed. Buccal folds within mouth rather narrow. Nostrils rather large, simple, front one near last third in

snout length and hind one little larger, elevated, close before eye above. Interorbital about level. Preorbital width narrow, entire slightly less than a third of eye. Preopercle edge minutely denticulate, with slight indenture above angle. Opercle ends in 2 rather weak points.

Gill-opening forward beyond front pupil edge though not quite to front eye edge. Rakers 8+16, lanceolate, robust, nearly half of eye-diameter. Gill-filaments short, about  $\frac{2}{3}$  of rakers. Pseudo-branchiæ very large, about long as rakers. Isthmus narrowly constricted, with groove in front.

Scales all finely ctenoid, smaller on breast, predorsal, edges of caudal peduncle, and head above. Above lateral scales in slightly inclined rows to dorsal profile, below in horizontal rows. Most of head scaly, except muzzle and broad rim around eye. Front of interorbital naked and squamation from occiput forward about opposite center of eye. Cheek with 5 rows of scales to preopercle ridge, and on preopercle flange row of broad scales with several smaller, scattered irregular scales. Subopercle, interopercle and opercle scaly, also sides of head above. Caudal covered with small scales, also bases of soft dorsal, anal, pectoral and ventral. Pointed free axillary ventral scaly flap,  $2\frac{1}{2}$  in fin. Lateral line complete, largely concurrent with dorsal profile, tubes simple and little exposed. On side of caudal peduncle lateral line little superior at first, median at caudal base.

Spinous dorsal inserted little behind pectoral origin, or little nearer soft dorsal origin than snout tip, spines long and slender, fourth longest and others graduated down, fin edge apparently little notched. Soft dorsal origin nearer caudal base than spinous dorsal origin, fin low, rounded or convex, last ray not produced, and not quite reaching caudal base. Anal begins about opposite soft dorsal origin, third spine longest with second little shorter, rayed fin little higher in front than soft dorsal and not extended so far posteriorly. Caudal moderate, hind edge very slightly emarginate. Pectoral long, falcate, reaches vent. Ventral inserted close behind pectoral base or but slightly before spinous dorsal origin, reaches  $1\frac{1}{2}$  to anal, spine  $1\frac{1}{2}$  in fin. Vent midway between ventral tips and anal origin.

Color in alcohol uniform pale brownish, fins scarcely tinted darker. Iris slaty.

Length 162 mm.

Type, No. 47,507, A. N. S. P.



Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Only the type known.

(*Méyas*, large; *ψ*, eye.)

*Nemipterus luteus* (Bloch).

A single example which agrees with the smaller one figured from Cavite by Jordan and Seale.<sup>15</sup> Though they state "scales about 44" their figure shows 48 tubes in the lateral line, a point in agreement with my example.

**MESOPRISTES** Bleeker.

*Mesopristes* Bleeker, Nat. Genes. Arch. Ned. Indie (Topogr. Batav.) II, 1845, p. 523. Type *M. macracanthus* Bleeker (= *Datnia argentea* Cuvier), monotypic.

This genus has been described under *Datnia* Cuvier by Day,<sup>16</sup> but as Cuvier's type is *Coius datnia* B. Hamilton by tautonomy, *Datnia* merges with the sparoids.

*Mesopristes plumbeus* (Kner). Ayungen.

*Datnia plumbea* Kner, Sitz. Akad. Wiss. Wien (May 12) 49, 1864, p. 484. Vom Capoder der Insel S. Paul.

—Kner, Reise. Novara, Fische, 1865, p. 48, Pl. 3, fig. 2. "Fundort unsicher, angeblich von Java."

*Therapon brevispinis* (non Steindachner) Peters, Monatsb. Ak. Wiss. Berlin, 1868, p. 256. Quingoa flum., Provinc Bulacan, Luzon, P. I.

*T. brachycentrus* Peters, l. c., 1869, p. 705.

? *T. kneri* Bleeker, Atlas Ich. Ind. Néerl., VII, 1873-6, p. 115. Based on *T. argenteus* (non Cuvier) Kner, Sitz. Ak. Wiss. Wien, 58, 1868, p. 299, Pl. 1, fig. 1. Kandavu, Fiji.

Head 3 to 3½; depth 2½ to 2¾; D. XII, 8 to 10; A. III, 8; scales 43 to 50 in lateral line to caudal base, and 3 or 4 more on latter; 7 or 8 scales above l.l. to spinous dorsal origin; 13 to 15 scales below l.l. to spinous anal origin; 16 to 20 predorsal scales; snout 3½ to 3¾ in head; eye 3¾ to 4; maxillary 3 to 3½; interorbital 3¾ to 3¾. Body compressed, deepest at front of spinous dorsal. Head compressed, upper profile slightly concave. Snout convex, length ¾ its width. Eye rounded, close to upper profile, hind edge little posterior from middle in head length. Maxillary slightly beyond front eye edge, not to pupil. Teeth fine, in bands in jaws, outer row little enlarged. Mouth roof toothless. Tongue free, elongate, rounded in front. Jaws about even. Front nostril slightly nearer eye than snout tip, hind one slit above eye. Hind preopercle edge finely serrate. Interorbital nearly flat. Rakers 9 or 10+18 or 19, lanceolate, 2 in filaments and latter 1½ in eye. Scales small, mostly uniform, smaller

<sup>15</sup> Bull. Bur. Fisher., XXV, 1906 (1907), p. 21.

<sup>16</sup> Fishes of India, I, 1875, p. 71.

along body edges and caudal base. Few small scales on soft dorsal and anal basally, also pectoral. Cheek with 5 rows of scales. L.l. concurrent with back and body scales in nearly parallel rows. Tubes small, simple, greatly exposed. Fourth dorsal spine  $1\frac{1}{2}$  in head, fin edge deeply notched. Soft dorsal small, well back, first ray  $2\frac{1}{2}$  in head. Second anal spine usually longest, 2 in head, though third often subequal. Caudal very slightly emarginate behind,  $1\frac{1}{2}$  in head. Pectoral rounded,  $1\frac{1}{2}$  in head. Ventral  $1\frac{1}{2}$  in head, spine  $1\frac{1}{2}$  in fin. Color in alcohol pale olive brownish above, each row of scales with slightly darker line. Spinous dorsal edge dusky, also soft dorsal, anal and caudal tinted with dusky, other fins pale. Iris pale slaty. Length 116 to 140 mm. Philippine Islands.

A very large series of individuals in the present collection, and they cover the discrepancies found in the accounts listed above. Kner's figure of *D. plumbea* does not show any small scales on the soft dorsal and anal bases. Bleeker has separated *T. kneri*, as Kner gives more numerous scales, and more pointed elevated dorsal and anal, etc. Jordan and Seale entirely overlook<sup>17</sup> Bleeker's reference and list *T. kneri* as "*T. argenteus* Kner," and as the locality Kandavu is in heavy-faced type, they may have thought it distinct from *T. argenteus* Cuvier, under which they place it.

*Upeneoides philippinus* sp. nov. Fig. 15.

Head  $3\frac{1}{2}$ ; depth  $3\frac{1}{2}$ ; D. VIII-I, 8, 1; A. I, 6, 1; P. II, 14; V. I, 5; scales 35 in lateral line to caudal base, and 4 more on latter; 3 scales above l.l. to spinous dorsal origin, and 7 below to spinous anal origin; 16 predorsal scales; head width  $1\frac{1}{2}$  its length; head depth at occiput  $1\frac{1}{2}$ ; snout  $2\frac{1}{2}$ ; eye  $4\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{2}$ ; second dorsal spine  $1\frac{1}{2}$ ; first branched dorsal ray  $2\frac{1}{2}$ ; anal spine 3; first branched anal ray 2; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body elongately ovate, deepest at spinous dorsal origin, edges all broadly convex. Caudal peduncle well compressed, least depth about  $1\frac{1}{2}$  in its length.

Head well compressed, flattened sides slightly converge below, profiles convex and upper more inclined. Snout convex in profile and over surface, nearly long as broad. Eye moderate, rounded, close to upper profile, and hind pupil edge about midway in head length. Mouth moderate, little inclined from horizontal, and lower jaw slightly included in upper. Maxillary reaches about opposite front pupil edge, expansion  $1\frac{1}{2}$  in eye. Lips rather narrow, fleshy.

<sup>17</sup> Bull. Bur. Fisher., 1905 (1906), p. 266.

Teeth granular, in about 3 irregular rows in each jaw. Patch of granular teeth on vomer and each palatine. Inner buccal folds narrow. Tongue fleshy, thick, not free. Mandible shallow, rami not elevated inside mouth. Barbels short, and scarcely extend beyond hind eye edge. Nostrils greatly distant, front one simple pore about last  $\frac{2}{3}$  in snout, hind one short slit close before eye. Interorbital very slightly convex. Preorbital broad, width slightly greater than eye. Preopercle edge entire. Opercle with 2 small concealed spines, close and above.

Gill-opening forward about opposite hind nostril. Rakers 6+10, VI, lanceolate, slender,  $1\frac{1}{2}$  in filaments, and latter  $1\frac{1}{2}$  in eye.

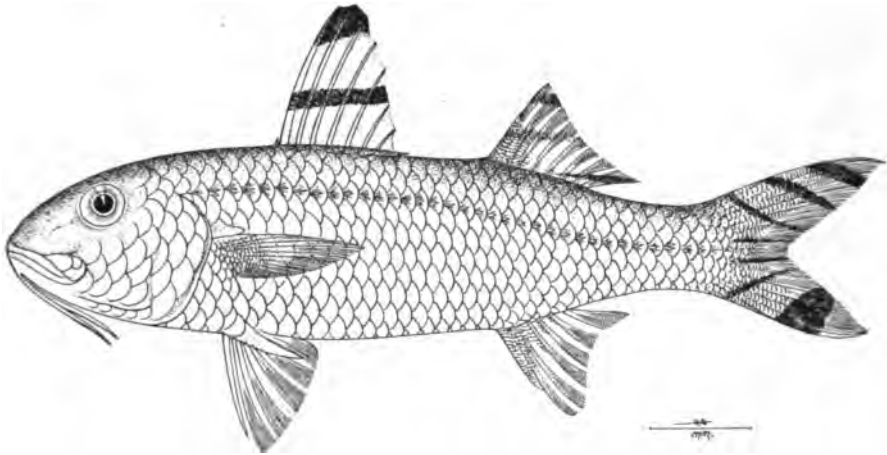


Fig. 15.—*Upeneoides philippinus* sp. nov.

Pseudobranchiæ about half length of gill-filaments. Isthmus narrowly constricted.

Scales uniformly large, finely ctenoid, in lengthwise rows parallel with lateral line. Small scales over most of caudal basally and front of soft dorsal and anal. Head scaly, and 2 rows of scales on cheek to preopercle ridge. Several large scales on exposed maxillary expansion. Pectoral axil with firm adipose scale above. Ventral with free pointed scaly flap  $1\frac{1}{2}$  in fin. Broad scaly flap between ventral bases  $\frac{1}{3}$  fin length. Lateral line concurrent with dorsal profile, well out on caudal base, tubes well exposed and each with several small branches.

Spinous dorsal inserted little nearer front nostril than second dorsal origin, second spine longest with third and fourth subequal, depressed fin  $\frac{1}{3}$  to soft dorsal. Last inserted midway between

spinous dorsal origin and caudal base, first branched ray longest with spine  $\frac{3}{4}$  its length, and depressed  $\frac{2}{3}$  to caudal base. Anal origin slightly behind second dorsal, fin similar though smaller. Caudal well forked, sharp pointed lobes about equal. Pectoral small, pointed, reaches  $1\frac{3}{4}$  to second dorsal origin. Ventral origin close behind pectoral base, though before spinous dorsal origin, reaches  $1\frac{1}{2}$  to anal. Ventral spine about  $\frac{5}{8}$  of fin.

Color in alcohol faded largely uniform dull brownish, lower surfaces scarcely paler. Spinous dorsal pale, apex broadly jet-black, and median brown horizontal band. Soft dorsal pale with three nearly horizontal dusky bands, uppermost apical and lowermost on hind rays. Caudal whitish, upper lobe crossed by three oblique broad dusky-brown bars, and lower lobe with two, but outer very broad and black. Median caudal rays also dusky. All other fins pale brownish. Iris pale slaty.

Length 180 mm.

Type, No. 47,508, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,509 to 47,511, paratypes, same data. These show: Head  $3\frac{1}{2}$  to  $3\frac{2}{3}$ ; depth  $3\frac{1}{2}$  to  $3\frac{2}{3}$ ; D. VIII-I, 8, 1; A. I, 6, 1; scales 35 in lateral line to caudal base and 4 more on latter; 3 scales above l.l. to dorsal origin, and 6 or 7 below to anal origin; 14 predorsal scales; snout  $2\frac{2}{3}$  to 3 in head; eye  $3\frac{1}{2}$  to  $4\frac{1}{2}$ ; maxillary  $2\frac{1}{4}$  to  $2\frac{3}{4}$ ; interorbital  $3\frac{1}{2}$  to 4; rakers 7 or 8+13, iv or 14, iv; length 120 to 149 mm.

Allied, if not identical with *Upeneoides vittatus* (Forsk&al), but apparently differs in the presence of but two black bars on the lower caudal lobe, the outer quite broad. The oldest synonym of *U. vittatus* is *Mullus bandi* Shaw,<sup>18</sup> based on Russell's *Badi goolivinda*.<sup>19</sup> This is doubtless *U. vittatus* and Russell says "the length seldom exceeds six inches." Shaw apparently copies Lacépède's crude figure, showing lower caudal lobe likely for the present or a closely allied species. Russell's figure has three dark lower caudal bars, but obliquely parallel with those of upper lobe! Russell also shows spinous dorsal tip not black, though fin crossed obliquely with three dark bars, and soft dorsal end dark, also fin crossed by two oblique dark bars. *Upeneus biteniatus* Bennett<sup>20</sup> is simply diagnosed with two golden bands below lateral line, and dorsal and caudal with oblique black streaks.

<sup>18</sup> Gen. Zool., IV, 1803, p. 615, Pl. 89.

<sup>19</sup> Fishes of Coromandel, II, 1803, p. 43, Pl. 158 (-60). Vizagapatam.

<sup>20</sup> Proc. Zool. Soc. London, 1830-1, p. 59. Mauritius.

Under *Upeneoides vittatus* later writers, as Günther,<sup>21</sup> Bleeker,<sup>22</sup> Day<sup>23</sup> and Sauvage<sup>24</sup> mention the lower caudal lobe with three dark oblique bars. Günther mentions two or three such bars, with adult material about a foot in length. Bleeker's figure shows greater upper portion of spinous dorsal black, only broad pink lengthwise band below middle. It also has soft dorsal apex black with two yellow lengthwise bands. Its caudal differs from Day's figure in innermost black bars leaving only narrow pale area, also tips of both lobes black, and bar next black tip on lower lobe twice wide as one nearer caudal base. Day's figure shows dark bars on lower caudal lobe evenly spaced, of about even width. Sauvage mentions three dark lower caudal bars, but his figure shows all the fins uniform and the body with four dark transverse bands. He includes in his table *U. taeniopterus* with *U. vittatus*, as a group with eight dorsal rays, though Day, who examined Valenciennes type of the former gives but seven.

Compared with *Upeneoides arge* Jordan and Evermann,<sup>25</sup> my examples of the present species differ as the former has pale tipped dorsal and caudal markings different. Jordan and Seale describe as *U. vittatus* Samoan material<sup>26</sup> closely approaching my specimens and refer to it as uete or vete. Two adult examples of *U. vittatus* before me from Tahiti, though in poor condition, still have traces of the fin markings, more as indicated in Bleeker's figure, and with four dark bars on each caudal lobe. Smith and Seale report *U. vittatus*<sup>27</sup> from Mindanao  $4\frac{1}{2}$  to 11 inches long with "each lobe of caudal with 5 or 6 oblique dusky bars."

(For the Philippine Islands.)

*Upeneoides belaque* sp. nov. Fig. 16.

Head  $3\frac{1}{4}$ ; depth  $3\frac{1}{4}$ ; D. VIII-I, 8, 1; A. I, 6, 1; P. 1, 13; V. I, 5; scales 35 in lateral line to caudal base and 4 more on latter; 3 scales above l.l. to spinous dorsal origin, and 7 below to spinous anal origin; predorsal scales 17; head width 2 in its length; head depth at occiput  $1\frac{1}{4}$ ; snout  $2\frac{1}{4}$ ; eye 4; maxillary  $2\frac{1}{4}$ ; interorbital  $3\frac{1}{4}$ ; second dorsal spine  $1\frac{1}{4}$ ; first branched dorsal ray  $1\frac{1}{4}$ ; first branched anal ray  $1\frac{1}{4}$ ;

<sup>21</sup> Cat. F. Brit. Mus., I, 1859, p. 397.

—Journ. Mus. Godeffroy (F. Süsser) II, 1873-5, p. 55. Samoa and Tahiti.

<sup>22</sup> Atlas Ich. Ind. Néerl., IX, 1877, Pl. 342 (2), fig. 3.

<sup>23</sup> Fishes of India, I, 1875, p. 120, Pl. 30, fig. 2.

<sup>24</sup> Hist. Nat. Madagascar, Pisc., XVI, 1891, p. 219, Pl. 27, fig. 2.

<sup>25</sup> Bull. U. S. F. Com., XXII, 1902 (April 11, 1903), p. 187. Honolulu.

<sup>26</sup> Bull. Bur. Fisher., XXV, 1905 (1906), p. 273. Samoa.

<sup>27</sup> Proc. Biol. Soc. Wash., XIX, 1906, p. 78.

anal spine  $2\frac{3}{4}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; upper caudal lobe 1; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body elongate, compressed, profiles nearly alike and deepest at spinous dorsal origin. Caudal peduncle compressed, least depth  $1\frac{1}{2}$  its length.

Head moderately ovate in contour, well compressed, flattened sides scarcely converge above or below, profiles alike and upper little more inclined. Snout convex in profile and over surface, long as broad. Eye moderate, rounded, elevated close to upper profile, and hind pupil edge about midway in head length. Mouth moderate, inclined little from horizontal, and lower jaw slightly included in upper. Maxillary about reaches to pupil center, expansion  $1\frac{1}{2}$  in

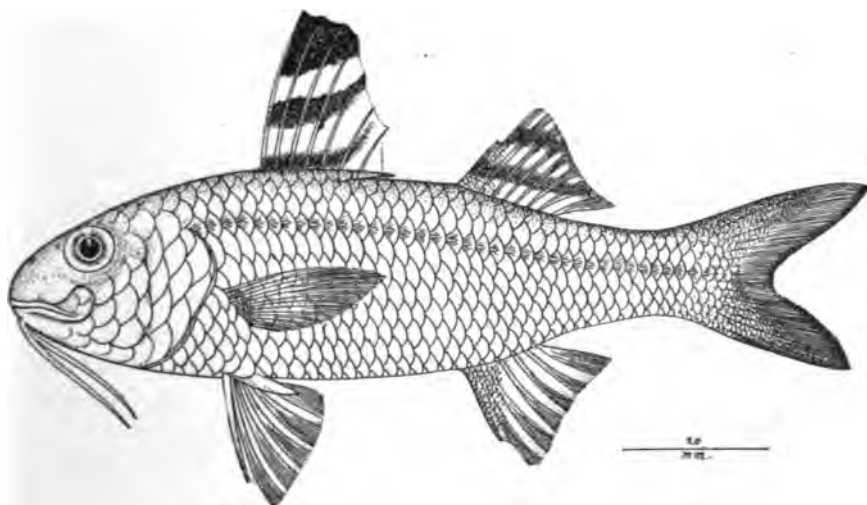


Fig. 16.—*Upeneoides belaque* sp. nov.

eye. Lips narrow, fleshy. Teeth granular in about 3 irregular rows in each jaw. Patch of granular teeth on vomer and each palatine. Inner buccal folds narrow. Tongue thick, fleshy, adnate. Mandible shallow and rami little elevated inside mouth. Barbels short, reach hind preopercle edge. Nostrils well separated, front one simple pore little nearer eye than snout tip, and hind one short slit close before middle of front eye edge. Interorbital slightly elevated convexly, flattened medially. Preorbital broad, width nearly equals eye. Preopercle edge entire. Opercle ends behind in 2 small close-set spines above, concealed by scales.

Gill-opening forward to front eye edge. Rakers 8+20, lanceolate,

slender,  $1\frac{1}{2}$  in filaments, and latter  $1\frac{1}{2}$  in eye. Pseudobranchiæ about  $\frac{2}{3}$  of gill-filaments. Isthmus moderately constricted.

Scales uniformly large, finely ctenoid, in lengthwise rows parallel with lateral line. Small scales over most of caudal base and front of soft dorsal and anal. Head scaly, and 2 rows of scales on cheek to preopercle ridge. Several large scales on exposed maxillary expansion. Pectoral with broad scale above its origin. Ventral with pointed axillary scale very slightly over half of fin length. Broad scaly flap (damaged) between ventral bases. Lateral line concurrent with dorsal profile, well out on caudal base, tubes well exposed as arborescent groupings at each scale base.

Spinous dorsal inserted about midway between front eye edge and second dorsal origin, first spine longest with second and third subequal, depressed fin  $\frac{7}{8}$  to second dorsal origin. Last inserted about midway between spinous dorsal origin and caudal base, first branched ray longest, with spine  $\frac{2}{3}$  length of first ray and depressed fin  $1\frac{1}{2}$  to caudal base. Anal origin slightly behind soft dorsal origin, fin similar. Caudal well forked, sharp pointed lobes about equal. Pectoral small, pointed, reaches about  $1\frac{1}{2}$  to second dorsal origin. Ventral origin about opposite pectoral origin, reaches  $1\frac{1}{2}$  to anal. Ventral spine about  $\frac{1}{2}$  of fin.

Color in alcohol faded largely dull uniform brownish, lower surfaces whitish. Fins all pale, at least ground-color. Spinous dorsal with broad black apex, two dusky horizontal bands, and penultimate membrane dusky. Soft dorsal with upper edge dusky and two pale dusky horizontal bands. Caudal uniform pale brownish, hind edge pale dusky. Iris pale slaty.

Length 120 mm.

Type, No. 47,512, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,513 to 47,517, paratypes, same data. They show: Head 3 to  $3\frac{1}{4}$ ; depth 3 to  $3\frac{1}{2}$ ; D. VIII-I, 8, 1; A. I, 6, 1, rarely I, 7, 1; scales 32 to 35 in l.l. to caudal base and 3 or 4 more on latter; 3 scales above l.l., and 7 below; 16 or 17 predorsal scales; snout  $2\frac{1}{2}$  to 3 in head; eye  $3\frac{1}{2}$  to 4; maxillary  $2\frac{1}{2}$  to  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{2}$  to  $3\frac{1}{2}$ ; rakers 8 or 9 + 19 to 22; length 69 to 140 mm.

Allied with *Upeneoides sulphureus* but when compared with Sumatran material differs in coloration and more numerous gill-rakers. *U. sulphureus* has but one horizontal dark band on each dorsal besides dark end or border.

(*Belaque*, the native name of the allied *U. sulphureus* at San Fabian, P. I.)

***Argyrosomus goldmani* (Bleeker).**

Small example and two adults which agree with Bleeker's figure, especially in length of second anal spine. My examples show latter  $2\frac{1}{2}$  in head, and jaws about even when closed.

***Sciæna dussumieri* (Valenciennes).**

Several examples. Contrary to the contention by Jordan and Thompson<sup>28</sup> that the "substitution of *Sciæna* for *Umbrina* by Bleeker is not warranted by the rules of the International Zoological Congress" in my opinion the type of a genus must be a species originally included in the genus under its distinct original binomial. As Gill designated *S. aquila* Cuvier the type of *Sciæna* Cuvier<sup>29</sup> which evidently was the *Cheilodipterus aquila* previously described by Lacépède and therefore definitely indicated a species not recognized by Linnæus or named in his original account, Gill's action is invalid. The first actual designation of *Sciæna cirrhosa* Linnæus as the type of *Sciæna* Linnæus, by Bleeker,<sup>30</sup> correctly argues that *Sciæna* supersede *Umbrina*, and the designation of *Sciæna umbra* by Jordan and others<sup>31</sup> is invalid.

***Polydactylus plebius* (Broussonet).**

Three examples. Jordan and Evermann are wrong<sup>32</sup> in attempting to fix *Polynemus paradiseus* Linnæus as the type of *Polynemus* Linnæus, as Gill designates *Polynemus quinquarius* Linnæus<sup>33</sup> many years before 1883. *Polydactylus* will therefore remain the correct generic name for the present species.

***Pomacentrus violaceus* Bleeker.**

Four examples, which agree in the squamation and general coloration as shown by Bleeker. He gives the pectorals as clear violaceous with their bases commonly with a spot or transverse blackish or dusky streak. *P. philippinus* Evermann and Seale is very closely allied, if not identical. It is figured with 3 rows of scales on the cheek, the lowest on the preopercle limb. Its teeth are said to be small and uniserial.

<sup>28</sup> Proc. U. S. Nat. Mus., XXXIX, 1911, p. 246.

<sup>29</sup> Proc. Acad. Nat. Sci. Phila., 1861, p. 82.

<sup>30</sup> Arch. Néerl. Sci. Nat. Harlem, XI, 1876, p. 326.

<sup>31</sup> Stanford Univ. Pub. (Genera of Fishes), 1917, p. 13.

<sup>32</sup> L. c., p. 15.

<sup>33</sup> Proc. Acad. Nat. Sci. Phila., 1861, p. 273.



*Pomacentrus grammorhynchus* sp. nov. Fig. 17.

Head  $3\frac{1}{2}$ ; depth  $1\frac{1}{2}$ ; D. XIII, 15, 1; A. II, 15, 1; P. II, 16, II; V. I, 5; tubes in upper arch of lateral line 18, and pores in straight section to caudal base 9; 3 scales between spinous dorsal origin and lateral line, and 10 below l.l. to spinous anal origin; 23 predorsal scales; head width  $1\frac{1}{2}$  in its length; head depth about  $1\frac{1}{2}$ ; snout 3; maxillary  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; first dorsal spine nearly 4; thirteenth dorsal spine  $1\frac{1}{2}$ ; eighth dorsal ray  $1\frac{1}{2}$ ; second anal spine 2; sixth anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $1\frac{1}{2}$ ; ventral spine  $1\frac{1}{2}$ .

Body robust, compressed, contour rather deeply ellipsoid, with

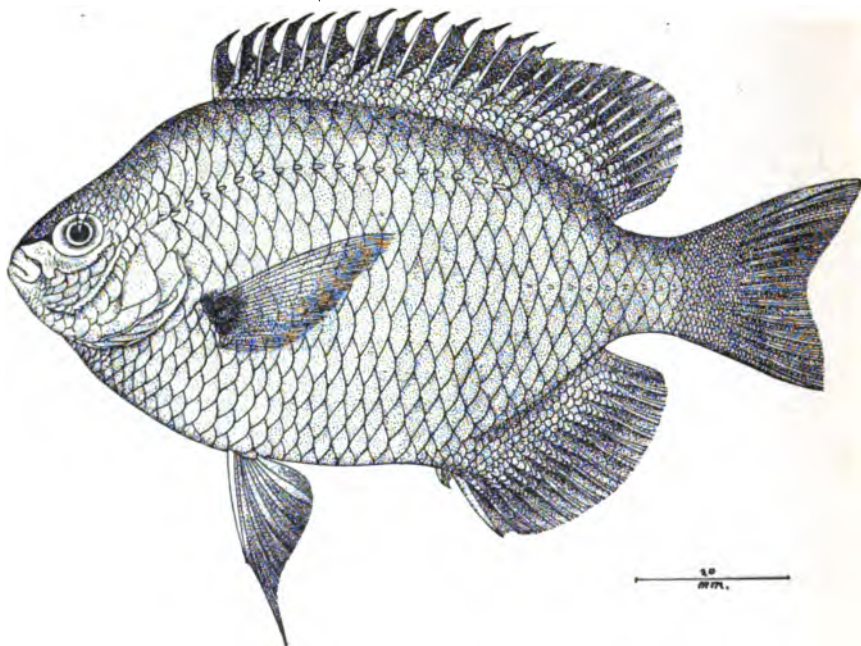


Fig. 17.—*Pomacentrus grammorhynchus* sp. nov.

greatest depth well over median region, predorsal slightly trenchant just before dorsal, otherwise edges convex, and profiles alike. Caudal peduncle compressed, length  $\frac{2}{3}$  its least depth.

Head robust, moderately compressed, sides moderately convex, upper profile at first convex, then concave at occipital and predorsal bulging distinctly convexly. Snout convex over surface and in profile, length half its width. Eye rounded, little elevated, and hind pupil edge nearly midway in head length. Mouth broad, gape short, oblique, and jaws about even. Lips fleshy, rather

narrow. Maxillary extends slightly beyond nostril, though not nearly to eye, and slips below preorbital. Teeth rather slender, somewhat compressed, pointed, crowded close to form an even cutting-edge in a single row. No teeth on mouth roof or on tongue. Inner buccal folds broad. Tongue thick, fleshy, apparently free in front. Nostril small pore about midway in snout length. Interorbital evenly convex. Preorbital broad, width about  $1\frac{1}{4}$  in eye, ends behind in broad posteriorly directed spine. Lower suborbital and hind preopercle edges serrate, serræ on latter graduated longer below, and lower preopercle edge entire. Opercle with 2 blunt and inconspicuous spines, upper concealed by scales.

Gill-opening forward about opposite front eye edge. Rakers  $6+13$ , lanceolate, about half length of filaments and latter  $1\frac{1}{4}$  in eye. Pseudobranchiæ long as gill-filaments. Branchiostegal membrane short fold over short and constricted isthmus.

Scales finely ctenoid, largest over middle of side of trunk and become much smaller all about edges, in lengthwise rows parallel with upper arch of lateral line. All larger scales narrowly imbricated. All fin bases scaly. Short scale between ventral bases about  $\frac{1}{4}$  length of spine. Suprascapula with 3 blunt points. Exposure of humeral scale little larger than pupil. Axillary ventral scale broad, pointed,  $\frac{1}{4}$  length of spine. Cheek with 3 rows of scales. Suborbitals, preorbital, snout edge, lips and chin naked. Upper arch of l.l. extends below front dorsal rays, concurrent with upper limit of squamation on dorsals. Tubes large, simple, and each extending well over scale exposure. Pores in straight section small, inconspicuous, simple or double irregularly, and not on caudal base.

Spinous dorsal origin about opposite that of pectoral, spines all more or less subequally high, edge of fin notched and slight cutaneous flap behind each spine tip. Soft dorsal inserted about last third in space between upper hind preopercle edge and caudal base, fin rounded with median rays longest. Anal inserted about midway between pectoral origin and caudal base, first spine about  $\frac{1}{3}$  of second. Soft anal similar to soft dorsal. Caudal deeply emarginate, upper lobe much larger,  $3\frac{1}{2}$  in combined head and trunk. Pectoral broad, about long as upper caudal lobe, reaches hind edge of vent and upper rays longest. Ventral inserted close behind pectoral base, reaches anal, and spine slightly over half length of fin.

Color in alcohol largely chocolate-brown above and posteriorly, head, breast and belly anteriorly paler or faded in appearance. Iris slaty. Dorsals and anals blackish-brown. Caudal pale brown-

ish. Pectoral brownish, with large blackish-brown blotch, nearly large as eye on base mostly above. Ventral blackish-brown, rays and spine pale. Dusky line from snout tip to eye.

Length 115 mm.

Type, No. 47,518, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Allied with *P. melanopterus* Bleeker, but differs in the presence of the dark line from the eye to the snout.

(Γραμμή, line; ρύγχος, snout.)

*Pomacentrus hebardii* sp. nov. Fig. 18.

Head 3; depth 2; D. XIII, 14, 1; A. II, 13, 1; P. II, 15; V. I, 5; tubes 17 in upper arch of lateral line and 8? pores in straight section to caudal base; 3 scales above l.l. to spinous dorsal origin and 9 below in vertical series to anal origin; 20 predorsal scales; head width  $1\frac{1}{2}$  its length; head depth 1; snout  $3\frac{1}{2}$ ; eye  $2\frac{1}{2}$ ; maxillary  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; last dorsal spine  $2\frac{1}{2}$ ; second anal spine 2; eleventh dorsal ray 2?; ninth anal ray  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral spine 2; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal 1.

Body well compressed, contour evenly and elongately ellipsoid, deepest medianly, and edges convexly rounded. Caudal peduncle compressed, length about  $\frac{2}{3}$  its least depth.

Head compressed, moderately large, rather flattened sides evenly converging above and below. Snout rather broad, slightly convex in profile and evenly so over surface, and length  $\frac{3}{4}$  its width. Eye rounded, little elevated, and hind pupil edge nearly midway in head length. Mouth small, short gape oblique, and lower jaw very slightly protruded. Lips moderate, fleshy. Maxillary extends back nearly opposite front eye edge. Teeth small, simple, compressed, rather obtuse and form as crowded in a single series nearly even cutting-edge. No teeth on mouth roof. Tongue pointed, depressed and smooth above, free in front. Inner buccal folds broad. Mandibular rami moderately elevated inside mouth. Nostril simple pore slightly behind middle in snout length. Interorbital slightly convex. Pre-orbital width  $2\frac{1}{4}$  in eye, with broad flat short spine directed back from hind edge. Suborbital edge with few irregular serræ below. Preopercle edge obliquely forward not quite opposite eye center, and 18 irregular serræ behind, though graduated larger downwards, and lower edge entire. Opercle with 2 obtuse short spines.

Gill-opening forward about opposite last  $\frac{2}{3}$  in eye. Rakers 6+13, lanceolate, slightly shorter than filaments, which 2 in eye. Pseudo-

branchiæ a little shorter than gill-filaments. Branchiostegal membrane moderately free over short constricted isthmus.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges, and at fin bases. Vertical fins covered basally with small scales. Suprascapula entire. Cheek with 3 rows of scales and lowest row on preopercle limb. Lips, chin, pre-orbital, suborbitals and snout edge narrowly, naked. Scales on snout above and top of head all small. Upper arch of lateral line

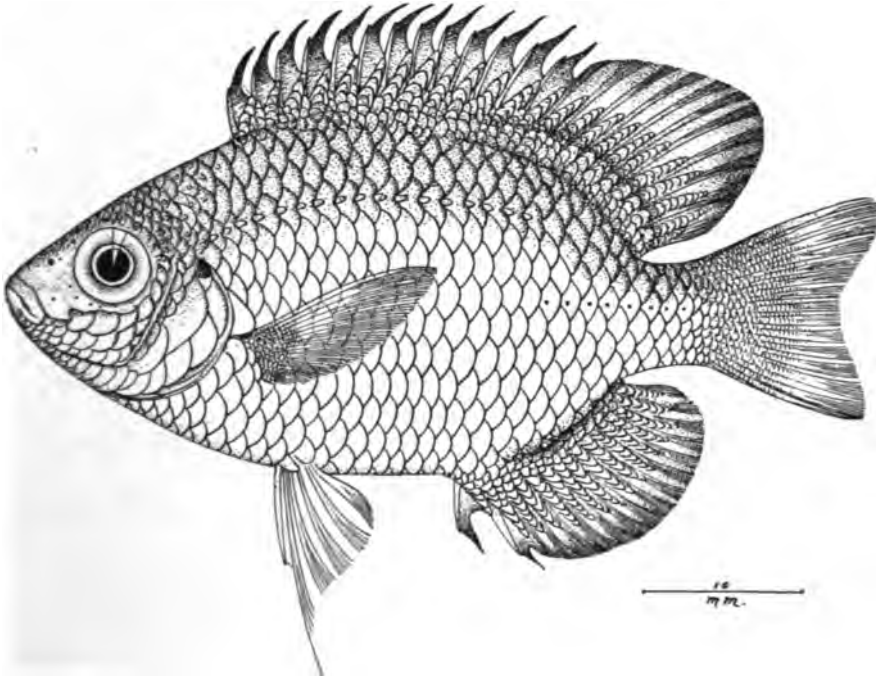


Fig. 18.—*Pomacentrus hebardi* sp. nov.

concurrent with limit of general squamation on dorsals, and extends back opposite soft dorsal origin. Tubes simple, large, extend over first half in each scale exposure. Pores in straight section simple, inconspicuous, and not on caudal base.

Spinous dorsal origin opposite pectoral origin, spines graduated up to fourth when largely subequal to last, fin edge notched and with cutaneous flap behind each spine tip. Soft dorsal origin at last third in space between hind eye edge and caudal base, and hind median rays longest. Spinous anal midway between pectoral origin and

caudal base, first spine about half length of second. Soft anal like soft dorsal. Caudal moderately emarginate behind. Pectoral long, about reaches anal. Ventral inserted close behind pectoral base, first ray ends in filament reaching second anal spine base. Vent close before anal.

Color in alcohol largely uniform brownish above, much paler below. Fins all largely pale, though marginal portions of spinous dorsal and anal dusky. Caudal pale to whitish. Very small dusky spot on uppermost scale of opercle. Another dusky spot, similar and about half size of pupil, at uppermost pectoral ray basally and above. Vent dusky. Iris slaty.

Length 56 mm.

Type, No. 47,519, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,520 to 47,525, paratypes, same data. These show: Head 3 to  $3\frac{1}{2}$ ; depth  $1\frac{1}{2}$  to 2; D. XIII, 13, 1 occasionally XIII, 14, 1 or XIII, 15, 1; A. II, 14, 1 sometimes II, 12, 1 or II, 13, 1; tubes in upper arch of l.l. 17, vary 14, 15 and 16; pores in straight section of l.l. 8; snout  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in head; eye  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; maxillary  $2\frac{1}{2}$  to 3; interorbital  $2\frac{1}{2}$  to  $3\frac{1}{2}$ ; length 43 to 54 mm. In these examples dusky vent quite characteristic.

Similar to *Pomacentrus moluccensis* Bleeker, but without a pale lengthwise line across anals, as shown in Bleeker's figure.<sup>24</sup> The latter also does not indicate a suborbital spine, which well developed in all of my examples.

(Named for Mr. Morgan Hebard of Philadelphia, an earnest student of Orthoptera, to whom I am indebted for small collections of fishes.)

*Pomacentrus burroughi* sp. nov. Fig. 19.

Head  $3\frac{1}{2}$ ; depth 2; D. XIII, 14, 1; A. II, 15, 1; P. II, 15; V. I, 5; tubes 13 in upper arch of lateral line, and 10 pores in straight section to caudal base; 3 scales above l.l. to spinous dorsal origin, and 9 below in vertical series to spinous anal origin; 20 predorsal scales; head width  $1\frac{1}{2}$  in its length; head depth 1; snout  $3\frac{1}{2}$ ; eye  $3\frac{1}{2}$ ; maxillary  $3\frac{1}{2}$ ; interorbitals 3; last dorsal spine  $1\frac{1}{2}$ ; second anal spine  $1\frac{1}{2}$ ; fifth dorsal ray  $1\frac{1}{2}$ ; eighth anal ray  $1\frac{1}{2}$ ; pectoral 1; ventral spine  $1\frac{1}{2}$ ; least depth of caudal peduncle 2; caudal about 1.

Body well compressed, contour rather deeply ellipsoid with greatest

<sup>24</sup> Atlas Ich. Ind. Néerl., IX, 1877, Pl. 3, fig. 3.

depth medianly, profiles alike, and edges convexly rounded. Caudal peduncle compressed, length about half its least depth.

Head compressed, rather small, rather flattened sides evenly converge above and below. Snout broad, convex, length  $\frac{3}{4}$  its width. Eye rounded, little elevated, hind pupil edge about midway in head length. Mouth small, short gape slightly oblique, and jaws nearly even or with lower very slightly included. Lips rather narrow, fleshy. Maxillary extends back to eye. Teeth small, simple, compressed, pointed, crowded to form rather even cutting-edge,

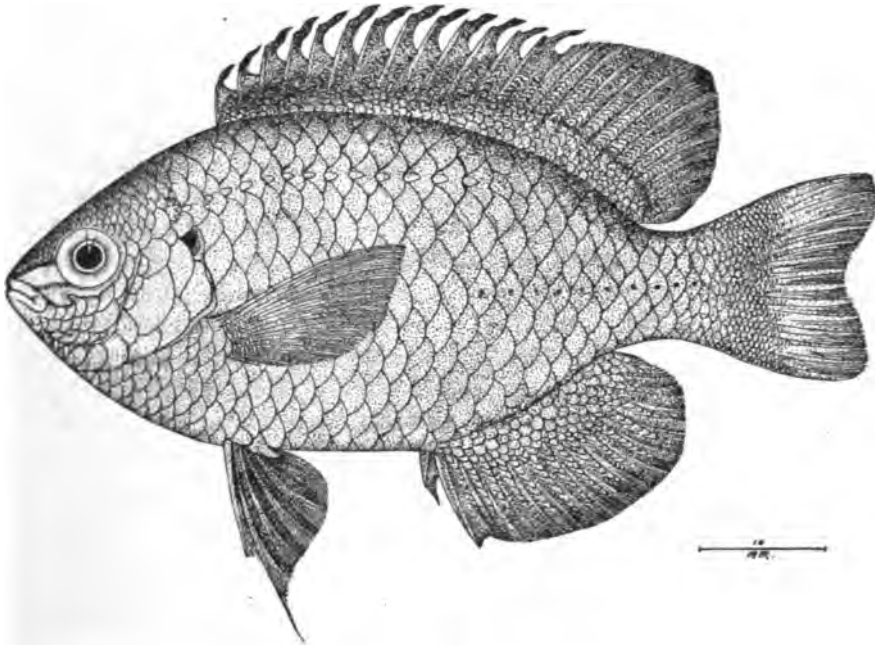


Fig. 19.—*Pomacentrus burroughi* sp. nov.

and in single series. No teeth on mouth roof. Tongue thick, pointed and free in front, smooth. Inner buccal folds broad. Mandibular rami rather well elevated inside mouth. Nostril simple pore slightly behind middle in snout length. Interorbital evenly convex. Preorbital width  $2\frac{1}{2}$  in eye, slips over upper maxillary edge, and with broad backwardly directed spine below at hind edge. Suborbital edge finely serrate below. Preopercle edge slopes forward with 19 serræ behind, lower edge entire. Opercle with 2 blunt points.

Gill-opening forward opposite front pupil edge. Rakers 6+10,

lanceolate, nearly long as filaments and latter half of eye. Pseudo-branchiæ long as gill-filaments. Branchiostegal membrane narrowly over narrow short constricted isthmus.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges except breast and caudal peduncle above and below. Vertical fins with at least basal half covered with fine crowded scales. Suprascapula entire. Cheek with 2 rows of scales. Lips, preorbital, suborbitals, edge of snout narrowly, and chin, naked. Upper arch of lateral line concurrent with limit of general squamation on dorsals, and extends back to soft dorsal origin. Tubes simple, large, and each well over scale exposure, last nearly to edge. Pores in straight section simple, inconspicuous, one in center of each scale exposure, and not on caudal base.

Spinous dorsal origin opposite that of pectoral, spines graduated up to fourth, after which subequally long to last, and fin edge notched, also cutaneous point behind each spine tip. Soft dorsal inserted nearly at last third in space between upper hind preopercle edge and caudal base, fin rounded, with median rays longest. Spinous anal inserted much nearer pectoral origin than caudal base, first spine nearly  $\frac{1}{3}$  of second. Soft anal like soft dorsal. Caudal slightly emarginate, and lobes rounded. Pectoral moderate, not quite reaching anal, though slightly beyond vent. Ventral inserted below hind pectoral base, reaches anal, first ray with slender filamentous tip, and spine half length of fin. Vent close before anal.

Color in alcohol uniform chocolate-brown generally, scarcely paler below. Fins also same general tint, except darker or mostly dusky, pectoral paler, and caudal still more so. Narrow obsolete dark line connects eyes around front of snout, including nostrils in its course. Uppermost opercular scale with conspicuous black blotch, though smaller than pupil. Inner pectoral axil brown, though at base of uppermost ray small black spot, smaller than spot on opercular scale.

Length 70 mm.

Type, No. 47,526, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,527, paratype, same data. Head 3; depth 2; D. XIII, 14; A. II, 14; upper arch of l.l. with 16 tubes and straight portion of 9 pores to caudal base; snout  $3\frac{1}{2}$  in head; eye  $2\frac{1}{4}$ ; maxillary  $3\frac{1}{8}$ ; interorbital  $3\frac{1}{8}$ ; length 57 mm.

Allied with *P. tripunctatus* Cuvier, but differs in the absence of the

black ocellus on the back of the tail, which Jordan and Seale state is apparently a distinctive character.<sup>35</sup> Bleeker gives six figures, though none exactly agree with my material.<sup>36</sup>

(For Dr. Marmaduke Burrough, 1798?-1844, who obtained fishes at Manila, which found their way to the Academy collection.)

*Pomacentrus opisthostigma* sp. nov. Fig. 20.

Head  $3\frac{1}{2}$ ; depth  $1\frac{1}{2}$ ; D. XIV, 12, 1; A. II, 15, 1; P. II, 15; V. I, 5; tubes 15 in upper arch of lateral line and 10 pores in straight section to caudal base; 4 scales above l.l. to spinous dorsal origin, and 10

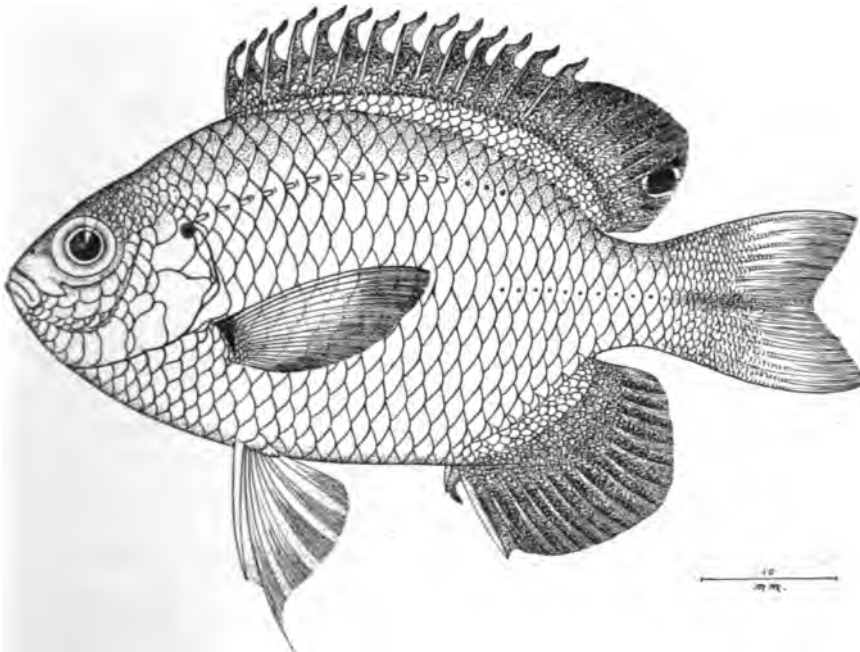


Fig. 20.—*Pomacentrus opisthostigma* sp. nov.

below in vertical series to spinous anal origin; 22 predorsal scales; head width  $1\frac{1}{2}$  in its length; head depth 1; snout  $3\frac{1}{2}$ ; eye  $3\frac{1}{2}$ ; maxillary  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; last dorsal spine 2 in head; second anal spine  $1\frac{1}{2}$ ; sixth dorsal ray  $1\frac{1}{2}$ ; eighth anal ray  $1\frac{1}{2}$ ; pectoral 1; ventral spine  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal about 1?

Body well compressed, contour rather deeply ellipsoid with greatest depth medianly, profiles largely alike except slightly humped pre-

<sup>35</sup> Bull. Bur. Fisher., XXV, 1905 (1906), p. 281.

<sup>36</sup> Atlas Ich. Ind. Néerl., IX, 1877, Pl. 7, figs. 1-6.



dorsal, and edges convexly rounded. Caudal peduncle compressed, length about  $\frac{3}{4}$  its least depth.

Head compressed, moderate, rather flattened sides evenly converging above and below. Snout wide, profile about straight, surface convex, and length  $\frac{3}{4}$  its width. Eye rounded, little elevated, hind pupil edge nearly midway in head length. Mouth small, short gape slightly oblique, and jaws about even. Lips rather narrow, fleshy. Maxillary extends back nearly opposite eye. Teeth small, simple, compressed, but little pointed, crowded to form nearly even cutting-edge in single row. No teeth on mouth roof. Tongue thick, pointed, free in front, smooth. Inner buccal folds broad. Mandibular rami rather well elevated inside mouth. Nostril simple pore slightly behind middle in snout length. Interorbital convex. Preorbital width 2 in eye, slips over most of upper maxillary edge, and hind edge with 2 short spines directed back. Suborbital edge finely serrate below. Preopercle edge obliquely forward not quite opposite eye center, finely serrate except several broader serræ at lower portion, and lower edge entire. Opercle with 2 short blunt points.

Gill-opening forward opposite front pupil edge. Rakers 8+15, lanceolate, longest  $\frac{1}{4}$  of filaments, which  $1\frac{1}{2}$  in eye. Pseudobranchiæ long as gill-filaments. Branchiostegal membrane narrowly over short constricted isthmus.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges and fin bases. Vertical fins finely and closely scaled over basal portions. Suprascapula entire. Cheek with 3 rows of scales. Lips, chin, preorbital, suborbitals and narrow edge of snout naked. Scales on snout above and top of head all small. Upper arch of lateral line concurrent with limit of general squamation on dorsals, extends back opposite twelfth dorsal spine base, though follow by 3 more pores till below front of soft dorsal. Tubes simple, large, well exposed or over first half of scale exposure. Pores in straight section simple, inconspicuous, one in center of each scale exposure, and not on caudal base.

Spinous dorsal origin opposite that of pectoral, spines graduated up to fourth, after which subequally long to last, and fin edge notched with cutaneous flap from behind each spine tip. Soft dorsal inserted at last third between suprascapula and caudal base, fin rounded, with median rays longest. Spinous anal inserted about midway between pectoral origin and caudal base, first spine nearly  $\frac{3}{4}$  of second. Soft anal like soft dorsal. Caudal a little emarginate

behind. Pectoral moderate, reaches  $\frac{7}{8}$  to anal or about opposite vent. Ventral inserted just behind pectoral base and reaches vent, spine  $\frac{3}{4}$  of fin. Vent close before anal.

Color in alcohol brownish generally, paler on belly and lower surface of head. Dorsals and anals deep brown to dusky. Last longest rays of soft dorsal with large black ocellus, not quite large as eye, on terminal portion of fin. Caudal, pectoral and ventral pale brownish. Pectoral axil pale, though external base with blackish-brown vertical wedge-shaped mark on upper portion. Uppermost opercular scale with dusky blotch, much smaller than pupil. Iris slaty.

Length 65 mm. (caudal tips slightly damaged).

Type, No. 47,528, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,529 and 47,530, paratypes, same data. These show: Head  $2\frac{1}{4}$  to  $3\frac{1}{8}$ ; depth 2; D. XIV, 13 or XIV, 14; A. II, 15; tubes in upper arch of l.l. 16 and pores in straight section 10 to 12 to caudal base; snout 3 to  $3\frac{1}{8}$  in head; eye  $2\frac{1}{8}$  to 3; maxillary 3 to  $3\frac{1}{8}$ ; interorbital 3 to  $3\frac{1}{4}$ ; length 41 to 61 mm. All show ocellus on soft dorsal well developed, but preorbital spines very variable, and they may be single or double, even in the same individual.

Apparently unique in its coloration this species is characterized by the large black ocellus behind and terminally on soft dorsal. With the preceding three species this one appears to fall in Bleeker's subgenus *Pseudopomacentrus*.

(Ὀπίσθεν, rear; στίγμα, spot.)

***Pomacentrus lividus* (Forster).**

Two small examples which do not show any scales on the lower limb of the preopercle, as in Bleeker's figure, and only 2 rows occur on the cheek.

***Chelodactylus labiatus* (Day).**

Two examples. Weber figures the head from his single example<sup>37</sup> and though his text says the scales on the cheek are in  $2\frac{1}{2}$  to 3 rows his figure shows 6 or 7. The former numbers are more in agreement with Day's figure, which is called *Pomacentrus labiosus*.<sup>38</sup>

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<sup>37</sup> Siboga Exped. Fische, 1913, p. 342, fig. 73. Beo, Karakelong I.

<sup>38</sup> Fishes of India, III, 1877, Pl. 81, fig. 2.

*Abudefduf antjerius* (Cuvier).

Two, which agree as outlined by Bleeker in his limits of color-variation, with reference to the dorsal ocellus absent or at dorsal base behind and diffusely dusky.

*Abudefduf philippinus* sp. nov. Fig. 21.

Head  $2\frac{3}{4}$ ; depth  $1\frac{1}{4}$ ; D. XIII, 11; A. II, 12; P. I, 14; V. I, 5; tubes in upper part of lateral line 17, and pores in straight section 7; 3 scales above lateral line to spinous dorsal origin and about 8 scales below in vertical row to spinous anal origin; about 14 predorsal

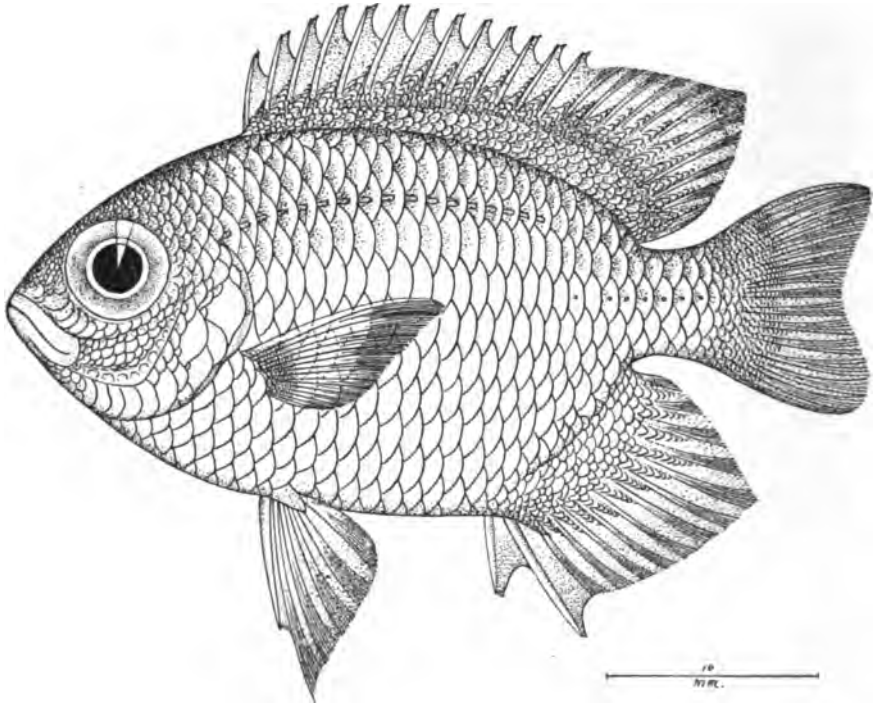


Fig. 21.—*Abudefduf philippinus* sp. nov.

scales; head width  $1\frac{3}{4}$  its length; head depth 1; snout  $3\frac{1}{4}$ ; eye  $2\frac{1}{4}$ ; maxillary  $3\frac{1}{2}$ ; interorbital  $2\frac{3}{4}$ ; third dorsal spine 2; thirteenth dorsal spine  $2\frac{1}{2}$ ; fifth dorsal ray  $1\frac{1}{2}$ ?; second anal spine  $1\frac{1}{2}$ ; fifth anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{6}$ .

Body well compressed, contour orbicular, deepest midway in length, predorsal with slight median keel and other edges convexly rounded. Caudal peduncle compressed, length  $1\frac{1}{2}$  in its least depth.

Head moderate, well compressed, evenly constricted above and below, profiles similarly inclined. Snout convex over surface, very slightly so in profile, length  $\frac{3}{4}$  its width. Eye large, close to upper profile, and hind pupil edge nearly midway in head length. Mouth well inclined, gape moderate, and jaws about even. Maxillary extends back slightly beyond front eye edge, though not quite to that of pupil, upper edge entirely slips below preorbital. Row of moderate, even, rather crowded, compressed incisors in each jaw, end of each tooth truncate, and whole forms even cutting-edge. No teeth on tongue or mouth roof. Tongue depressed, pointed, free. Inner buccal folds broad. Lips fleshy, moderately wide. Nostril slightly behind middle in snout length. Interorbital convex. Preorbital width  $3\frac{1}{4}$  in eye. Hind preopercle edge slopes well forward, so that angle would fall nearly opposite center of eye, and like lower preorbital and suborbital edges, entire.

Gill-opening forward opposite front pupil edge. Rakers 7+16, lanceolate, longest about long as gill-filaments or 3 in eye. Pseudo-branchiæ slightly longer than gill-filaments. Isthmus narrowly constricted, trenchant, branchiostegal membrane moderately broad across.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges. Fins all scaly basally. Suprascapula thin, entire, small. Cheek with 4 rows of scales. Opercle with moderate scales, small on interorbital, and still smaller on upper part of snout. Moderate scales on suborbitals and preorbital. Chin, lips, and narrow strip on front of snout naked, though mandible scaly. Scaly ventral flaps damaged. Lateral line with upper branch curving up at first, and then largely concurrent with upper limit of general squamation on dorsal fins, and ends below soft dorsal origin. Tubes simple, large, extend nearly over first half in scale exposure. Pores in horizontal section inconspicuous, small, and one in middle of each scale exposure, not on caudal base.

Spinous dorsal inserted opposite pectoral origin, spines rapidly graduated up to third, then subequal, fin edge well notched. Soft dorsal origin nearly at last third between upper hind preopercle edge and caudal base, rays graduated up to sixth and seventh, which form sharp point behind. Spinous anal inserted well before soft dorsal, first spine about 3 in second, or fin origin nearly midway between ventral origin and caudal base. Soft anal like soft dorsal. Caudal (damaged) apparently little emarginate behind. Pectoral reaches anal. Ventral inserted below middle of pectoral base,

nearly reaches soft anal origin, and spine nearly  $\frac{3}{4}$  fin length. Vent close before anal.

Color in alcohol largely faded dull brownish generally, predorsal, head above and front of back with traces of darker mottlings. Fins all pale uniform brownish. Iris slaty.

Length 41 mm. (caudal tip damaged).

Type, No. 47,531, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

No. 47,532, paratype, same data. It shows: Head  $2\frac{1}{2}$ ; depth  $1\frac{1}{2}$ ; D. XIII, 11; A. II, 12; tubes in upper arch of l.l. 17 and pores in straight portion 7; snout  $3\frac{1}{2}$  in head; eye 2; maxillary 3; interorbital  $2\frac{1}{2}$ ; length 36 mm.

Apparently falls within the subgenus *Amblyglyphidodon* Bleeker, and without much in common with the four East Indian species Bleeker describes.

*Abudefduf parasema* sp. nov. Fig. 22.

Head  $3\frac{1}{2}$ ; depth  $2\frac{1}{2}$ ; D. XIII, 11, 1; A. II, 12, 1; P. II, 13; V. I, 5; tubes in upper arch of lateral line 13, followed by oblique row of 4 pores and finally 8 pores in horizontal section to caudal base; 2 scales above l.l. and spinous dorsal origin, and 9 below in vertical series to spinous anal origin; 15 predorsal scales; head width  $1\frac{1}{2}$  in its length; head depth at hind eye edge 1; snout  $3\frac{1}{2}$ ; eye  $2\frac{1}{4}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; fifth dorsal spine 2; third dorsal ray  $1\frac{1}{2}$ ; second anal spine  $1\frac{1}{2}$ ; third anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{10}$ ; caudal (damaged)  $1\frac{1}{4}$ ?; pectoral  $1\frac{1}{8}$ ; ventral spine  $1\frac{1}{4}$ .

Body well compressed, profiles evenly convex to form even ellipsoid contour, edges rounded, and greatest depth midway in length. Caudal peduncle compressed, length  $\frac{3}{4}$  its least depth.

Head moderately large, well compressed, flattened sides evenly and slightly constricted above and below, profiles alike. Snout slightly convex in profile, surface also convex, length  $\frac{1}{2}$  its width. Eye large, rounded, little elevated, well advanced. Mouth small, jaws about even. Maxillary small, reaches very slightly beyond front eye edge. Lips thin, narrow. Teeth small, uniserial, ends truncate. Inner buccal folds narrow. Tongue pointed, free, depressed. Nostril at last third in snout, simple pore with slight cutaneous rim. Interorbital convex. Preorbital width about 3 in eye, deeply notched but entire along edge. Preopercle edge entire and slopes forward about opposite hind eye edge.

Gill-opening forward about opposite front pupil edge. Rakers 4+16, lanceolate, slender, about long as filaments or  $2\frac{1}{2}$  in eye. Pseudobranchiæ about long as gill-filaments. Isthmus narrowly constricted, short.

Scales ctenoid, narrowly imbricated, in even lengthwise rows, little smaller along body rows. Fins all scaly basally. Suprascapula thin, entire. Cheek with 2 rows of scales. Scales on opercles moderate, small on top of head. Lips, snout broadly, preorbital and suborbitals naked. Broad scaly flap between ventral bases about half length of fin. Ventral axilla with small pointed scale

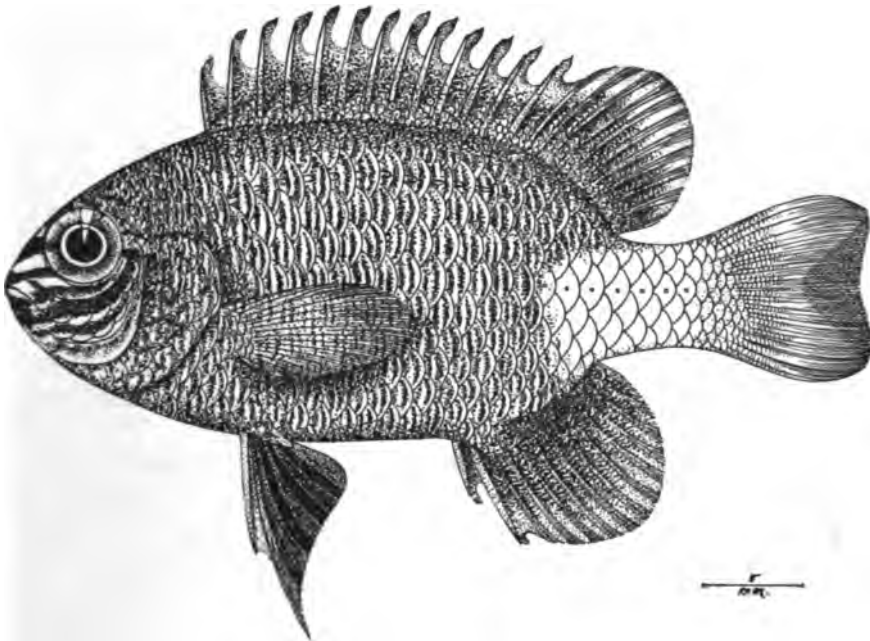


Fig. 22.—*Abudedefduf parasema* sp. nov.

about 3 in spine. Height of large humeral scale equals  $\frac{3}{4}$  of eye-diameter. Lateral line with upper branch curving up at first and then follows concurrently along back with upper limits of general squamation, though continues as several simple pores to caudal peduncle. Pores in horizontal section small, inconspicuous and one in middle of each scale exposure, not on caudal base.

Spinous dorsal inserted opposite pectoral origin, spines graduated up to fifth, then subequal, fin edge well notched and slight cutaneous point behind each spine tip. Soft dorsal origin at last third between

spinous dorsal origin and caudal base, rays graduated to fourth which longest. Spinous anal origin little nearer pectoral origin than caudal base, first spine about  $\frac{2}{3}$  of second. Soft anal graduated to fifth or longest ray, fin pointed behind like soft dorsal. Caudal small (damaged) and apparently rounded. Pectoral moderate, rather broad, nearly reaches anal. Ventral inserted close behind pectoral base, fin to second anal spine base, and fin length 3 in combined head and trunk length. Vent close before anal.

Color in alcohol deep chocolate-brown, caudal peduncle and caudal fin white in contrast. Vertical fin dusky-brown. Muzzle with 4 oblique dusky-chocolate streaks. Dark bar at pectoral origin and base. Each scale with dark blotch on head and dark vertical bar on each larger scale on trunk. Iris pale slaty. Hind caudal edge with moderately broad pale brown shade. Teeth pale.

Length 43 mm.

Type, No. 47,533, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also, Nos. 47,534 to 47,537, paratypes, same data. These show: Head 3 to  $3\frac{1}{2}$ ; depth 2; D. XIII, 11, 1; A. II, 12, 1; scales 13 to 15 with tubes, then 3 or 4 pores, and finally 8 or 9 pores in horizontal section of lateral line; 2 or 3 scales above l.l. and 8 or 9 below; 17 to 19 predorsal scales; snout  $3\frac{1}{2}$  to  $3\frac{3}{4}$  in head; eye  $2\frac{2}{3}$  to 3; maxillary 3 to  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$  to  $2\frac{7}{8}$ ; length 37 to 43 mm.

Related to *Glyphidodon lacrymatus* Quoy and Gaimard,<sup>39</sup> which differs in coloration, the figure without black pectoral blotch and caudal only slightly paler or about same tint as pectoral. *G. lacrymatus* also shows scattered and rather large obscure bluish spots on back. *Abudefduf sapphirus* Jordan and Richardson has somewhat similar head markings, but has the tail and caudal peduncle like rest of body.

(*Ιλαράσσημα*, streamer, with reference to the pale tail.)

CTENOGLYPHIDODON subgen. nov.

Type *Abudefduf melanopselion* sp. nov.

Body of oblong contour. Preorbital broad, with entire edge. Hind preopercle edge entire. Gill-rakers very long and slender, also numerous or about 76 on first arch. Front border of snout, or space before nostrils, naked. Preorbitals and suborbitals scaleless. Of three rows of scales on cheek lowest row on preopercle limb.

<sup>39</sup> Voy. Uranie, Zool., 1825, p. 388, Pl. 22, fig. 7.

This subgenus appears unique in its very fine and numerous gill-rakers.

(*Κτετα*, comb; *Glyphidodon*, an old name for *Abudefduf*; with reference to the fine gill-rakers.)

*Abudefduf melanopselion* sp. nov. Fig. 23.

Head 3; depth  $2\frac{1}{2}$ ; D. XIII, 14, 1; A. II, 15, 1; P. II, 13; V. I, 5; tubes in upper arch of lateral line 16, followed by 3 pores as one on each scale sloping down behind, then 5 pores in straight section on side of caudal peduncle; 5 scales in vertical series between l.l. and

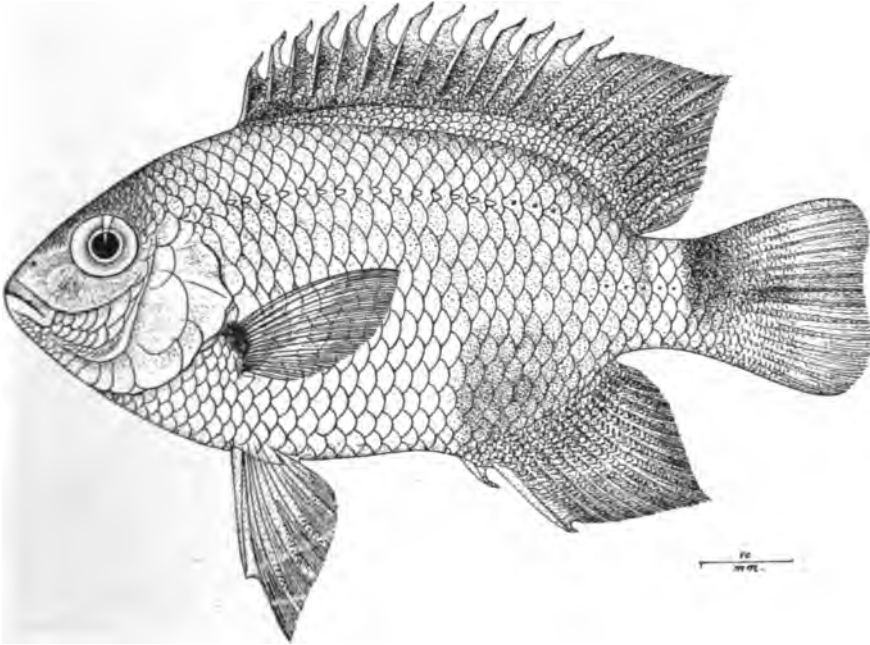


Fig. 23.—*Abudefduf melanopselion* sp. nov.

spinous dorsal origin, and 10 below in vertical series to spinous anal origin; 21 predorsal scales; head width  $1\frac{1}{2}$  its length; head depth 1; snout  $2\frac{1}{2}$ ; eye  $3\frac{1}{2}$ ; maxillary  $3\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; last dorsal spine  $1\frac{1}{2}$ ; seventh dorsal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; second anal spine 2; seventh anal ray  $1\frac{1}{2}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

Body well compressed, rather deep, and greatest depth median, edges rounded or predorsal scarcely trenchant. Caudal peduncle compressed, least depth twice its length.

Head moderately large, well compressed, evenly constricted above and below, upper profile little more inclined. Snout nearly straight



in profile, convex over surface, length about  $\frac{4}{5}$  its width. Eye large, round, close to upper profile and hind pupil edge midway in head length. Mouth slightly inclined, jaws about even, gape short. Maxillary reaches about first  $\frac{3}{4}$  in space between nostril and eye, entirely slips below broad preorbital. Teeth as row of rather even crowded compressed incisors, as single cutting-edge, and each tooth with end rather broad, or truncate, though slightly emarginate medially. No teeth on roof of mouth or tongue. Inner buccal folds broad. Tongue free, pointed and depressed. Lips moderately broad. Nostril simple pore slightly before middle in snout length. Interorbital convex. Preorbital width  $1\frac{1}{4}$  in eye. Hind preopercle edge slopes well forward or about opposite eye center, and both it and preopercle ridge, also preorbital edge, entire.

Gill-opening forward about opposite hind maxillary end. Rakers  $31+45$ , lanceolate or very slender,  $1\frac{1}{2}$  in eye. Gill-filaments 2 in eye, pseudobranchiæ equally long. Isthmus narrowly constricted forward with narrow branchiostegal membrane.

Scales ctenoid, narrowly imbricated, in even lengthwise rows, smaller along body edges. Fins all scaly basally. Suprascapula thin, entire. Cheek with 2 rows of scales. Scales on opercles moderate and small on top of head. Lips, preorbital, suborbitals and front edge of snout naked, also front of mandible. Scaly flap between ventral bases barely half of spine, and pointed axillary ventral scale about  $\frac{2}{3}$  of spine. Height of large humeral scale equals eye-diameter. Lateral line with upper branch curving up at first and then follows concurrently along back with upper limits of general squamation to end below front of soft dorsal. Tubes simple, large, over first half of each scale exposure. Pores in horizontal section small and inconspicuous, and one in middle of each scale exposure, not on caudal base.

Spinous dorsal inserted opposite pectoral origin, spines rapidly graduated up to third or fourth, then slightly so to last, fin edge well notched, and cutaneous flap from each spine tip behind. Soft dorsal origin little before last third in space between pectoral origin and caudal base, rays graduated to seventh, which longest and forms pointed tip behind reaching back half-way in caudal. Spinous anal origin midway between that of pectoral and caudal base, first spine  $\frac{2}{3}$  length of second. Soft anal graduated to seventh ray, fin pointed behind like soft dorsal. Caudal (damaged) apparently truncate behind, broad. Pectoral moderate,  $1\frac{1}{2}$  to anal, upper rays longest. Ventral inserted about opposite middle of pectoral base, spine  $\frac{2}{3}$

length of fin and latter not quite to anal origin. Vent about midway between ventral spine tip and spinous anal origin.

Color in alcohol pale russet-brown on front, shading off on front of back to chocolate-brown above medianly and posteriorly, which latter tint uniformly over dorsals. Region above anal, caudal fin, and anal fin chocolate-brown, fins of darker tint. Pale transverse streak on caudal peduncle and caudal base with broad dark transverse area. Median caudal rays dusky, outer pale. Dusky-brown blotch on upper half of pectoral base and slightly on humeral scale also. Lower surface of head, breast and belly all pale or light brownish. Lips grayish. Iris pale slaty. Pectoral grayish, paler below. Ventral blackish-brown, front and hind margins broadly pale.

Length 93 mm.

Type, No. 47,538, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

(Μέλας, black; φέλιον, bracelet; with reference to the black pectoral bases.)

*Chromis seotochilepterus* sp. nov. Fig. 24.

Head  $3\frac{1}{4}$ ; depth 2; D. XIII, 11; A. II, 11; P. II, 16; V. I, 5; tubes in upper arch of lateral line 19, and 9 in straight section to caudal base; 3 scales above l.l. to spinous dorsal origin, and 9 scales in vertical row below to spinous anal origin; predorsal scales about 32; head width  $1\frac{2}{3}$  in its length; head depth 1; mandible  $2\frac{2}{3}$ ; fourth dorsal spine 2; fourth dorsal ray  $1\frac{1}{2}$ ; second anal spine  $1\frac{1}{2}$ ; sixth anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle 2; ventral  $1\frac{1}{8}$ ; snout 4 in head measured from upper jaw tip; eye 3; maxillary  $2\frac{2}{3}$ ; interorbital 3.

Body well compressed, contour deeply ellipsoid, greatest depth midway in its length, edges convex. Caudal peduncle well compressed, length  $\frac{2}{3}$  its least depth.

Head large, deep, compressed, flattened sides slightly constricted below, and upper profile slightly steeper. Snout slightly convex in profile, length half its width. Eye large, rounded, scarcely elevated, hind edge but slightly behind center in head length. Mouth oblique, gape moderate, lower jaw slightly protruded. Maxillary reaches slightly beyond front eye edge, not quite to pupil. Lips rather narrow, fleshy. Teeth short, strong, conic, in outer row in each jaw, and those in front little larger than others. Inner teeth fine, minute, crowded close behind outer row. No teeth on roof of mouth or on tongue. Inner buccal folds broad. Rami of mandible but little elevated inside mouth. Nostril about last  $\frac{2}{3}$  in snout length,

simple, moderate pore. Interorbital convex. Preorbital partly ensheaths upper maxillary edge, width 3 in eye. Hind preopercle edge slightly emarginate, whole edge entire.

Gill-opening extends forward opposite hind maxillary edge. Rakers  $10+13$ , lanceolate, about  $\frac{1}{2}$  of filaments, and latter  $1\frac{1}{2}$  in eye. Pseudobranchiæ long as gill-filaments. Isthmus narrowly constricted forwards, with rather narrow branchiostegal membrane across.

Scales finely ctenoid, narrowly imbricated, in even lengthwise rows more or less converging behind, and smaller along body edges.

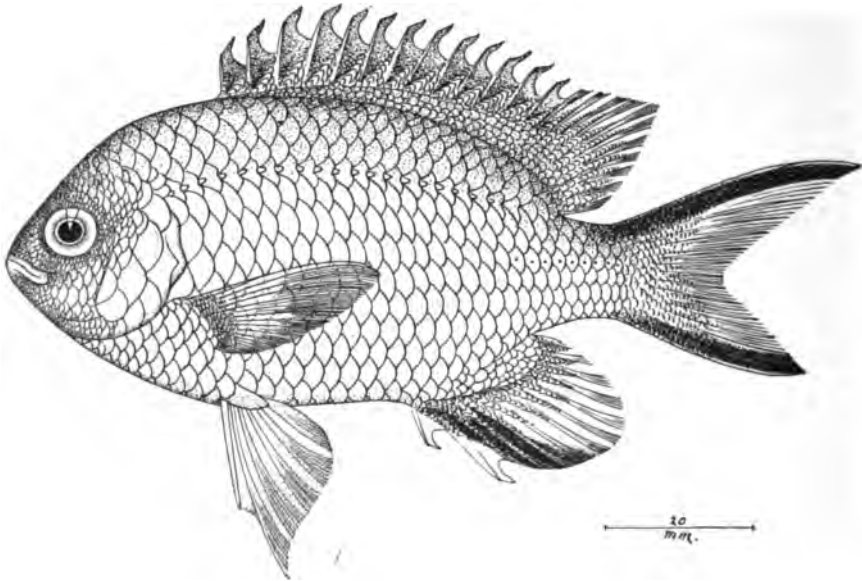


Fig. 24.—*Chromis scotochilopterus* sp. nov.

Fins all scaly basally. Suprascapula small, thin, entire. Head scaly, except lips, and on muzzle, suborbitals and interorbitals smaller scales crowded closely. Cheek with 6 rows of scales, two median rows enlarged. Opercles with moderately large scales. Humeral scale moderate. Ventrals with median scaly flap  $\frac{2}{3}$  of fin, and pointed axillary scale  $\frac{1}{4}$ . Upper branch of lateral line curving up at first, then concurrent with upper limit of general squamation on dorsal fins, and ends below front basal region of soft dorsal. Tubes simple, large, and well over front half of each scale exposure. Pores in horizontal section simple, small, one in middle of each scale exposure, and 2 irregularly on caudal base.

Spinous dorsal inserted about over ventral origin, spines graduated up to fourth after which subequal, fin edge notched and cutaneous flap from behind tip of each spine. Soft dorsal inserted nearly at last fourth in space between pectoral origin and caudal base, rays graduated up to fifth which forms point extending back well beyond caudal base. Spinous anal inserted midway between pectoral origin and caudal base, first spine 3 in second. Soft anal more rounded than soft dorsal, first 6 rays subequal. Caudal deeply forked, about  $2\frac{1}{2}$  in combined head and trunk, lobes sharply pointed and upper much longer. Pectoral reaches vent, which close before anal. Ventral reaches slightly beyond vent to anal, and insertion close behind pectoral base. Ventral spine  $\frac{2}{3}$  of fin.

Color in alcohol largely dull uniform brownish, scarcely paler below. Some small obscure whitish spots sprinkled on opercles and upper side of head, along middle of side and near depressed pectoral tip. Head brownish above, especially interorbital and upper snout surface. Iris slaty. Spinous dorsal blackish-brown. Soft dorsal blackish-brown basally, which broadly so at first and narrowly behind, rest of fin white. Dark color of this fin also reflected on adjacent region of back. Caudal white, except upper and lower borders broadly, to tips of lobes, which blackish-brown. Anals white, except along front edge of soft anal broad blackish-brown band to hindmost tip of fin. Pectoral pale, with small brownish axillary blotch above, though not extending on outside of fin. Ventral brownish, darker terminally. Apparently whole general coloration more or less olivaceous when fresh.

Length 115 mm.

Type, No. 47,539, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also No. 47,540, paratype, same data: Head  $3\frac{1}{2}$ ; depth 2; D. XIII, 11; A. II, 11; tubes in upper arch of l.l. 18, and 7 in straight section to caudal base; snout 4 in head measured from upper jaw tip; eye  $2\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{2}$ ; length 75 mm.

Allied with *Chromis xanthochir* (Bleeker), but differs in its coloration as represented in his colored figure.<sup>40</sup>

(Σκοταίος, dark; χείλος, edge; πτερον, fin.)

*Chromis philippinus* sp. nov. Fig. 25.

Head  $3\frac{1}{2}$ ; depth  $1\frac{1}{2}$ ; D. XII, 11; A. II, 11; P. II, 15; V. I, 5; tubes in upper arch of lateral line about 15, and 9 pores in straight portion

<sup>40</sup> Atlas Ich. Ind. Néerl., IX, 1877, Pl. 3, fig. 5.

to caudal base; 3 scales above l.l. to spinous dorsal origin, and 9 below in vertical series to spinous anal origin; about 23 predorsal scales; head width  $1\frac{3}{4}$  in its length; mandible  $2\frac{1}{4}$ ; third dorsal spine  $2\frac{1}{2}$ ; twelfth dorsal spine 3; fourth dorsal ray  $1\frac{1}{4}$ ; second anal spine  $2\frac{1}{4}$ ; sixth anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle 2; pectoral 1; ventral 1; snout  $3\frac{1}{2}$  in head measured from upper jaw tip; eye  $2\frac{1}{2}$ ; maxillary 3; interorbital  $2\frac{3}{4}$ .

Body well compressed, contour somewhat ovoid with greatest depth near spinous dorsal front, and edges all convex. Caudal peduncle compressed, about long as deep.

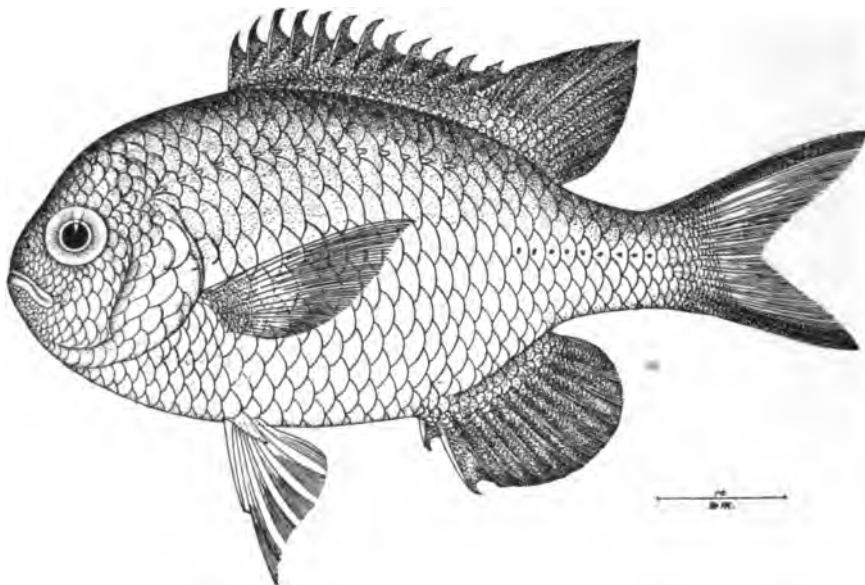


Fig. 25.—*Chromis philippinus* sp. nov.

Head rather large, well compressed, flattened sides slightly constricted below, profiles similarly and nearly evenly convex. Snout convex in profile and over surface, length  $\frac{2}{3}$  its width. Eye circular, large, but slightly elevated and hind pupil edge about midway in head length. Mouth small, oblique, gape short, and closed lower jaw slightly protrudes. Maxillary small, extends back very slightly beyond front eye edge. Lips fleshy, rather narrow. Teeth fine, simple, conic, strong, in bands in jaws, and entire outer row enlarged, especially anteriorly. No teeth on mouth roof or on tongue. Inner buccal folds broad. Tongue broad, depressed and free. Nostril simple pore at last  $\frac{2}{3}$  in snout. Interorbital convex. Preorbital

ensheaths upper maxillary edge, its width  $2\frac{1}{2}$  in eye. Hind preopercle edge obliquely forward opposite hind pupil edge, little emarginate below, and entire.

Gill-opening forward opposite front eye edge. Rakers 9+20, lanceolate, very slender, slightly less than filaments or latter about 2 in eye. Pseudobranchiæ about as long as gill-filaments. Isthmus narrowly constricted, especially anteriorly, with rather narrow branchiostegal membrane across.

Scales finely ctenoid, narrowly imbricated in even lengthwise rows somewhat converging behind, and smaller along body edges. Fins all scaly basally. Suprascapula small, entire. Head scaly, except lips, and on snout and mandible scales quite small. Cheek with 4 rows of scales, and a single row of broad ones on preorbital. Scales on opercle moderate. Humeral scale large as eye. Small scales on breast and pointed scaly flap between ventral bases 3 in fin, and pointed axillary scaly flap about same. Upper branch of lateral line curves up at first, then concurrent with upper limit of general squamation on dorsal fins, and ending below soft dorsal origin. Tubes simple, large, and extend well over each scale or for about first  $\frac{2}{3}$  its exposure. Pores in horizontal section mostly simple and single, though some few double, all median on each scale exposure, and not on caudal base.

Spinous dorsal inserted about opposite hind basal pectoral edge, spines slightly graduated to third, others more or less subequal, and fin edge notched. Soft dorsal inserted about last third in space between hind preopercle edge and caudal base, graduated to fourth and fifth rays, which form point behind extending slightly beyond caudal base. Spinous anal inserted nearer pectoral origin than caudal base, first spine nearly  $\frac{2}{3}$  length of second. Soft anal little more oblong than soft dorsal, little shorter behind. Caudal deeply forked, subequal lobes sharply pointed,  $2\frac{2}{3}$  in combined head and trunk. Pectoral reaches second anal spine base. Ventral inserted below last half of pectoral base, reaches nearly to anal, and spine about  $\frac{1}{2}$  of fin. Vent about midway between depressed ventral spine tip and anal origin.

Color in alcohol dark brown above generally, and lower surface paler. Traces of obscure mottling or spots on head above and back especially anteriorly. Under surface of head, with lips pale. Iris slaty. Dorsals blackish-brown, also anals. Caudal with lengthwise blackish-brown band broadly on upper lobe above and lower lobe

below, rest of fin paler or gray-brown. Pectoral and ventral pale brown.

Length 70 mm.

Type, No. 47,541, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

Also Nos. 47,542 to 47,547, paratypes, same data. These show: Head 3 to  $3\frac{1}{4}$ ; depth  $1\frac{1}{2}$  to 2; D. XII, 11, once XII, 10; A. II, 11, rarely II, 10 to II, 12; tubes in upper arch of l.l. 15, rarely 14; pores in straight portion of l.l. 10, rarely 9 or 12; snout  $3\frac{1}{2}$  to 4 in head measured from upper jaw tip; eye  $2\frac{3}{4}$  to  $2\frac{7}{8}$ ; maxillary  $2\frac{1}{2}$  to  $3\frac{1}{8}$ ; interorbital  $2\frac{3}{4}$  to  $2\frac{7}{8}$ ; length 58 to 75 mm. Some of the smaller ones show a slight depression concavely above eye in upper profile.

Allied with *Chromis ternatensis* (Bleeker), especially in its pale anal and dark edged caudal, though differs in its preorbital not half so wide as in Bleeker's figure.<sup>41</sup> Day's figure of *Heliastes lepidurus*<sup>42</sup> is close in proportions, and is likely identical with the present species. His figure differs in a radiation of scales below the eye and the dark pectoral spot appears above the pectoral base and not on the base of first ray.

HOPLOCHROMIS subgen. nov.

Type *Heliastes caeruleus* Cuvier.

Differs from the subgenus *Chromis*, as represented by the preceding species, in the presence of external outwardly directed conic teeth in each jaw.

("Οπλον, armour; *Chromis*; with reference to the external series of teeth.)

*Chromis caeruleus* (Cuvier).

Six examples.

*Callyodon philippinus* sp. nov. Fig. 26.

Head 3; depth  $2\frac{3}{4}$ ; D. IX, 10, 1; A. III, 9, 1; P. II, 12; V. I, 5; scales in lateral line 19+5 to caudal base and 2 more on latter; 2 scales between spinous dorsal origin and l.l. and 6 below in vertical series to spinous anal origin; 6 predorsal scales; head width 2 in its length; head depth  $1\frac{1}{2}$ ; snout  $2\frac{1}{4}$ ; eye  $6\frac{3}{4}$ ; maxillary 5; interorbital  $2\frac{3}{4}$ ; third dorsal spine 3; first dorsal ray  $2\frac{3}{4}$ ; third anal spine  $3\frac{1}{2}$ ; third anal ray  $2\frac{3}{4}$ ; least depth of caudal peduncle  $2\frac{1}{4}$ ; caudal  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ .

<sup>41</sup> Atlas Ich. Ind. Néerl., IX, 1877, Pl. 4, fig. 4.

<sup>42</sup> Fishes of India, III, 1877, Pl. 82, fig. 1.

Body compressed, contour elongately ellipsoid, deepest about midway in its length, and edges convexly rounded. Caudal peduncle well compressed, length about  $\frac{3}{4}$  its least depth.

Head large, compressed, flattened sides about evenly constricted above and below, and upper profile a little more evenly convex than lower. Snout convex in profile and over surface, long as wide. Eye small, a little elevated, rounded, and its center nearly midway in head length. Mouth small, gape inclined forward, jaws even. Lips thin, broad, not covering teeth. Teeth welded into sharp-edged even cutting-edge. Two large upper posterior canines and larger lower one on each side. Inner buccal membranes broad. Tongue

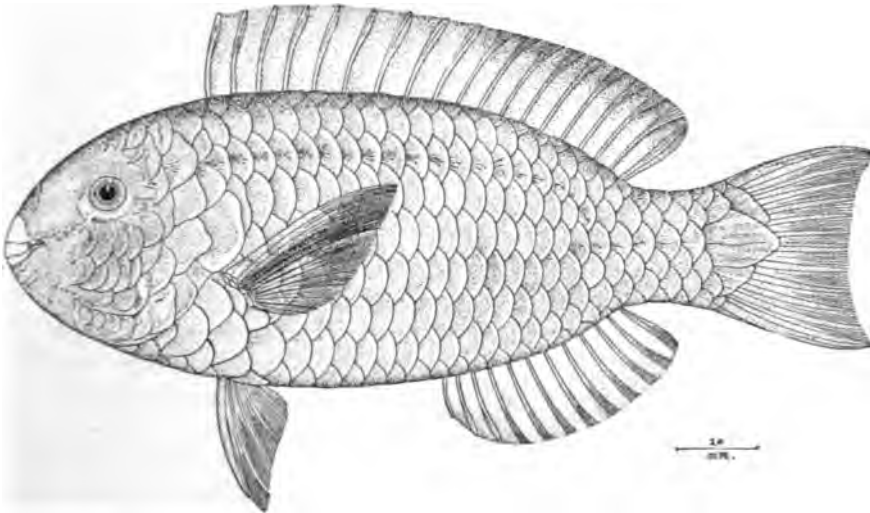


Fig. 26.—*Callyodon philippinus* sp. nov.

thick, depressed, apparently not free. Maxillary not half way in snout, not nearly to front nostril. Nostrils small, lateral, inconspicuous, little separated, hind one about  $\frac{3}{4}$  an eye-diameter before eye and both near level of upper eye edge. Interorbital broadly convex. Opercular flap narrow.

Gill-opening extends forward close behind hind nostril. Rakers 32 very short weak flexible points on outer edge of first arch, and about 52 slender setæ-like rakers on inner edge, which latter about  $3\frac{1}{2}$  in gill-filaments. Gill-filaments 2 in snout length. Pseudo-branchiæ about  $\frac{1}{3}$  of gill-filaments. Isthmus narrowly constricted, gill-membranes adnate.

Scales large, cycloid, and those on middle of sides with exposed



width a little less than half of exposed depths. Snout, interorbital, preorbital, muzzle and lower limb of preopercle anteriorly, naked. Cheek with 2 rows of broad scales. Several large scales on opercle. Fins, except base of caudal which covered with large scales, naked. Smaller scales along bases of dorsals and anals. Round scale between ventral bases about  $\frac{1}{2}$  of fin, and pointed axillary scale about  $2\frac{1}{2}$ . Lateral line concurrent with back, slopes down below bases of last dorsal rays and midway along side of caudal peduncle on caudal base. Tubes in first section of lateral line with several branches, all small, main stem most conspicuous and branches small.

Origin of spinous dorsal about over that of pectoral, spines more or less equal, rather flexible adipose ends present, and edge of fin entire. Soft dorsal origin little nearer upper corner of gill-opening than caudal base, membranes very shallowly emarginate along fin edge, and rays subequally high. Anal spines graduated to third, which longest, each ending in flexible adipose-like end. Soft anal like soft dorsal. Closed caudal slightly concave behind, when expanded nearly truncate and corners always sharp-pointed. Pectoral broad, upper rays longest, and fin  $\frac{1}{2}$  to anal. Ventral inserted about opposite pectoral origin, fin about  $\frac{1}{2}$  to anal, and spine ends in flexible adipose-like tip  $\frac{1}{2}$  of fin length. Vent close before anal.

Color in alcohol faded pale brownish with traces of olivaceous. Dorsals marginally with broad pale band length of both fins. Anal with similar submarginal band lengthwise. Caudal uniform brownish. Pectoral pale olive, but second, third and upper portions of fourth branched rays with their intervening rays dark brown, forming a lengthwise dark band. Ventral pale uniform brownish. Upper lip broadly pale, and with narrow line from mouth corner back to eye. Also short pale line from behind eye over postorbital, besides several smaller ones below, at lower edges. Small broken bars and spots of pale brownish on under surface of head. Iris slaty.

Length 215 mm.

Type, No. 47,548, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

This species somewhat resembles *Callyodon rivulatus* (Valenciennes) as figured by Bleeker,<sup>43</sup> but differs in the coloration, as there are no traces of the green median spots on the soft dorsal, the dark pectoral band is lower on the fin, and it does not show the spots and bars of pale color on the under surface of the head.

<sup>43</sup> Atlas Ich. Ind. Néerl., I, 1862, p. 44, Pl. 9, fig. 3.

***Siganus fuscescens* (Houttuyn).**

Large series, mostly young. These identical with material from Bacon, P. I., upon comparison. All have a dark shoulder-blotch and dark spots or blotches on trunk.

***Siganus corallinus* (Valenciennes).**

One which differs slightly from a Sumatran example in the smaller dark spots on the head, doubtless due to age. Both agree largely with Müller and Schlegel's account. The alleged closely related *Chaetodon guttatus* Bloch shows no dark spots on the head. Surely the figure by Quoy and Gaimard of their *Amphacanthus argenteus* cannot refer to this genus as it is shown with five dorsal spines and three anal spines. Its trunk is clouded olive and brown, and there is a white bar on the caudal peduncle.

***DROMBUS* Jordan and Seale.*****ULCIGOBIUS* subgen. nov.****Type *Drombus maculipinnis* sp. nov.**

Differs from subgenus *Drombus* in the higher spinous dorsal, larger scales and very conspicuous pores on the sides of the head. Ventrals joined, at least for their basal halves.

Probably *D. tutuilæ* Jordan and Seale belongs in the present group.

(*Ulcis*, boil, with reference to the pores on the side of the head; *Gobius*.)

***Drombus maculipinnis* sp. nov. Fig. 27.**

Head 3; depth  $3\frac{1}{2}$ ; D. VI-10; A. I, 7; P. I, 14; V. I, 5; scales 23 in median lateral series from shoulder to caudal base and 3 more on latter; about 7 scales between second dorsal origin and anal origin; about 6? predorsal scales; head width  $1\frac{1}{2}$  in its length; head depth at occiput  $1\frac{1}{2}$ ; mandible  $3\frac{1}{2}$ ; first dorsal spine slightly less than head; eighth dorsal ray  $1\frac{1}{2}$ ; last anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{6}$ ; pectoral 1; ventral  $1\frac{1}{2}$ ; snout  $3\frac{1}{2}$  in head measured from upper jaw tip; eye  $4\frac{1}{2}$ ; maxillary  $3\frac{1}{2}$ ; interorbital about 2 in eye.

Body moderately long, compressed though little robust anteriorly and deepest about second dorsal origin. Body edges all rounded convexly. Caudal peduncle compressed, slightly longer than deep.

Head large, elongate, profiles similar, cheeks and lower sides greatly and evenly swollen backward, with upper head surface more constricted than lower. Snout convex over profile and surface, length  $\frac{2}{3}$  its width. Eye moderate, superior, advanced, largely directed upward. Mouth small, broad, gape extends about first  $\frac{1}{2}$  in snout. Mandible broad, protrudes, rather shallow. Lips thick,

fleshy, firm. Teeth in rather broad villiform bands in jaws, none on vomer, palatines or tongue. Inner buccal folds both rather broad. Tongue large, thick, oblong, adnate, and front end rather broadly truncate. Nostril small pore in depression at base of snout close before eye, but not visible in superior view. Interorbital deep narrow groove between elevated supraorbital ridges.

Gill-opening entirely lateral, long as space between mandible tip and front eye edge. Rakers 2+6, III, lanceolate, slightly less than filaments, and latter about half of eye. Isthmus broad, width equals snout and half of eye.

Scales large, ctenoid, moderately exposed, in even lengthwise

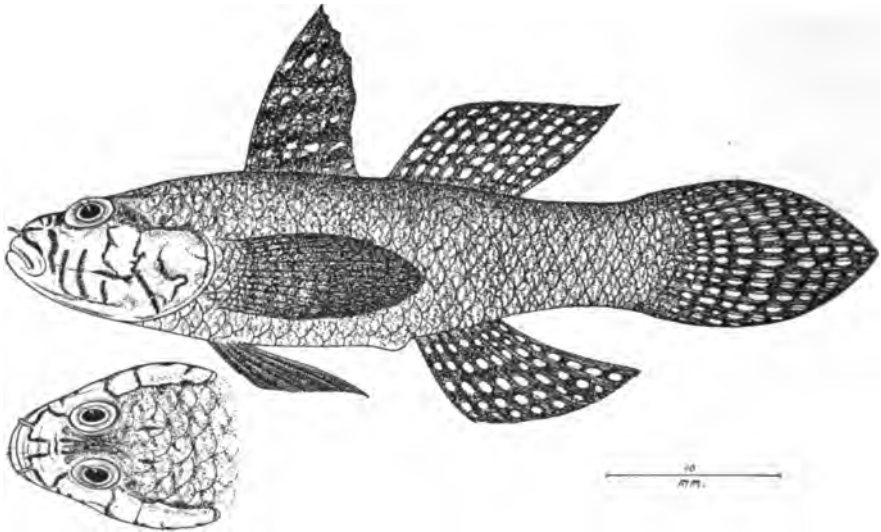


Fig. 27.—*Drombus maculipinnis* sp. nov.

rows. Caudal base scaly. Head scaly, with numerous transverse cutaneous narrow areas on cheek, side of head and snout. Cutaneous flap each side of snout tip nearly equal to pupil in length. Fins other than caudal apparently scaleless and without scaly flaps. No l.l.

Spinous dorsal inserted little nearer mandible tip than last dorsal ray base, first spines elongate, flexible and reach about  $\frac{2}{3}$  in second dorsal base. Origin of soft dorsal much nearer caudal base than hind eye edge, median and posterior rays little longer, and last ones reach caudal base. Anal origin close behind dorsal origin, fin similar to soft dorsal only smaller. Caudal elongate and ends in median

point behind. Pectoral large, with broad base, and reaches little beyond anal origin. Ventral inserted below gill-opening close before pectoral base, fins united for their basal halves, and reach large vent close before anal. Ventral spine small, about  $\frac{2}{3}$  length of fin.

Color in alcohol dark chocolate-brown, with basal pockets of scales dusky to blackish, and together with paler spots producing a mottled appearance. Fins all blackish or dusky-brown, barred or spotted with whitish. Cutaneous areas on head dark. Iris slaty.

Length 50 mm.

Type, No. 47,549, A. N. S. P.

Philippine Islands. Presented by the Commercial Museums of Philadelphia.

*Drombus palackyi* Jordan and Seale<sup>44</sup> has smaller scales, about 31 in a lateral series, body more slender or with the depth 6 and fins not marked with white.

(*Macula*, spot; *pinna*, fin.)

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<sup>44</sup> Proc. U. S. Nat. Mus., XXVIII, 1905, p. 797, fig. 15.

## MARCH 19.

HENRY SKINNER, M.D., Sc.D., in the Chair.

Fifty persons present.

The death, on February 26, of Samuel Gibson Dixon, M.D., LL.D., Sc.D., President of the Academy, having been announced, the following minute prepared for a special meeting of the Council by John Cadwalader, LL.D., Vice President of the Academy, was read:

This Academy has met the most serious loss in the death of its President, SAMUEL GIBSON DIXON. The death of an officer who has been twenty-two years in the service of such an institution inflicts a loss not easily compensated.

When a man of Dr. Dixon's earnest character, unusual attainments and unflagging zeal in every cause which he espoused, is lost to the community, it becomes a public calamity.

It would be hard to find a man whose services had been of more value to his associates, and to the public generally, than were those of Dr. Dixon.

He was unusually well equipped for efficiency by early education. He thus came to the bar, at that time the commanding profession. The influence of an office discipline as well as Law School instruction still existed, and lawyers were truly men of affairs as well as legal advisers and could adapt themselves to all demands made upon them more readily than could men of any other training.

Having a natural trend of thought and interest in the pursuit of science, he entered the other great learned profession—medicine, after a very thorough preparation. A man in mature life who seeks a new vocation is apt to throw a deeper interest into what he undertakes, as he cannot afford to make another experiment.

Dr. Dixon's work in his profession and here in The Academy of Natural Sciences of Philadelphia, and for many years in his great office, presiding over the Health Department of the State, cannot be properly dealt with in a brief minute. A fitting tribute to his work and memory will be paid at a suitable time.

To-day we meet to record our deep sense of the loss of an able presiding officer, a loyal friend to the institution over which he presided, and a personal colleague whose friendship we all treasured. His colleagues tender to his family profound sympathy in their bereavement.

The death of George Barrie, a member, January 4th, was also announced.

*Eruptions of the Costa Rican Volcano Irazú in 1917-18.*—DR. PHILIP P. CALVERT stated that the first and greatest known eruption of Irazú occurred in 1723, from February intermittently to December. A contemporary account by the Spanish Governor of Cartago, Don Diego de la Haya, exists and has been reprinted several times.

A recent report by Prof. Tristán refers to eruptions of "smoke" or of vapors seen by visitors to the old craters in 1844, 1847, 1855, 1859, 1870, 1880, 1884, 1888, and 1910.

*La Información*, a daily paper of San José, for October 6, 1917, published a despatch from a correspondent who visited the craters of Irazú on the preceding day, in which he stated that they were violently exhaling large columns of steam, rising at times to a height of 70 meters, accompanied by sulphurous odors, rumbling sounds and small volcanic stones.

This notice led Prof. J. Fidel Tristán, accompanied by Señores Alvaro Fernández Peralta and Ewald Starke to visit the volcano on October 19 and 20, 1917. A report (that alluded to above) by Prof. Tristán and Señor Ricardo Fernández Peralta on the observations made on these days was subsequently published in *La Gaceta, Diario Oficial* (Official publication of the Costa Rican Government), for December 4, 1917. It is accompanied by reproductions of some photographs taken by Prof. Tristán and a plan of the craters in eruption. This report has been reprinted in better form as No. 1, Series A, *Publicaciones, Colegio de Señoritas*, San José, 1917.

Professor Tristán found that craters D, E, G, H, L and M (following the designations of Dr. Karl Sapper) were discharging vapor. A fuller series of the October photographs than were included in this report has been sent by Prof. Tristán to the speaker, as well as others taken by Señores José Maria Tristán on December 19, 1917, and Ricardo Fernández Peralta on December 20, 1917, in the craters, and telephotographs from San José by Prof. Tristán in January, 1918. All these photographs were shown on the screen and the speaker added explanatory remarks based on Prof. Tristán and Señor R. F. Peralta's report, articles from various issues of *La Información* and his own visits to the volcano in 1909 and 1910. The later photographs show the chief discharge as being from crater G. A considerable fall of ash and scoriæ was reported as occurring on December 19 and January 6 and 7, reaching on the last date to San José.

Samples of the ash collected in San José and forwarded by Mr. J. B. Clark, and of ash from the eruption of Poás, of January, 1910, were exhibited under microscopes. The former is much darker than the latter; Prof. Alfaro, director of the National Museum in San José, is quoted in *La Información* of January 8, 1918, as saying that the Irazú ash was produced by decomposition of andesite and contained but little sulphur, while that of Poás was due to calcination of pumice and (when first fallen) contained much sulphuric acid.

The communication was illustrated by lantern views.

MR. JAMES A. G. REHN gave an outline of the work of the Southern Arizona Expedition of 1916. (No abstract.)

Mr. Francis R. Cope was elected a member.

The following were elected Correspondents:

George Howard Parker, of Cambridge, Massachusetts;  
Alfred Goldsborough Mayer, of Tortugas;  
Charles Richard Van Hise, of Madison, Wisconsin;  
John Campbell Merriam, of Berkeley, California;  
John Henry Comstock, of Ithaca, New York;  
Herbert Spencer Jennings, of Baltimore, Maryland;  
Frank Rattray Lillie, of Chicago, Illinois.

The following were ordered to be printed:

THE RECTAL TRACHEATION AND RECTAL RESPIRATION OF THE LARVÆ OF  
ODONATA ZYGOPTERA.

I. RECTAL TRACHEATION OF ARGIA PUTRIDA LARVA.

BY ANNA M. CULLEN.

*Argia moesta putrida* Hagen is a Zygopterous dragonfly of wide distribution throughout the eastern United States. Its larvæ occur in flowing streams, the material studied having been collected at Cobb's Creek near Beechwood Park, Pennsylvania, May 25, 1914. The larva sectioned was killed in hot Gilson (Bolles Lee, *Microtometist's Vade Mecum*, Third Edition p. 472). It was stained with Delafield's hæmatoxylin and alcoholic eosin. The rectal tracheation was studied from a series of paraffin sections extending through the sixth, seventh, eighth and ninth segments of the larva.

The *alimentary canal* in this region will be considered first. At the beginning of the hind gut, in the posterior part of the sixth segment, the epithelium has six deep longitudinal folds. In this region the epithelium is somewhat thin. In the anterior half of the seventh segment the alimentary canal is triangular in section. This triangular appearance is caused by three patches of thickened epithelium, one dorsal in position, the others right ventral and left ventral. Between the three patches of thickened epithelium are small areas of thin pigmented epithelium. Tracheæ penetrate the thickened epithelium. No tracheæ enter the thin pigmented epithelium. The alimentary canal in the posterior half of the seventh segment and the beginning of the eighth segment is extremely thin-walled. Toward the middle of segment seven the patches of thickened epithelium disappear and the alimentary canal becomes thin-walled and folded. At first the folds have no definite arrangement but gradually six definite folds appear, three large ones alternating with three small ones. The six folds soon become equal in size and using the clock face notation of Tillyard, the folds occupy the positions of 2, 4, 6, 8, 10, and 12 of the clock face. Toward the posterior end of segment seven the folds gradually disappear and the alimentary canal is thin-walled, and oval, almost rectangular in outline. This part of the larva contains few of the smaller tracheæ, none of which approach the alimentary canal. In the anterior part



of segment eight, the longitudinal rectal folds begin to appear in the epithelium. These folds become deeper and extend all through segment eight and part of segment nine. Of the three folds, one is dorsal, one may be called right latero-ventral and the third left latero-ventral (Fig. 1); in spite of their positions, shown in this figure, they appear to correspond to folds 12, 4, and 8 of the clock face. Between the folds there are thin pigmented areas. Toward the posterior end of segment nine and continuing through segment ten, the folds become gradually less pronounced until they form merely three thickened areas of the rectal wall. Between these areas of thickened epithelium, the rectal wall is extremely thin and projects inward as a ridge. Since there are three areas of thickened epithelium, of course there are three of these thin inwardly projecting ridges. All along through segments eight and nine tracheæ penetrate the thickened epithelium but no tracheæ enter the thin areas. Toward the middle of the ninth segment the thin epithelium between the longitudinal folds becomes spongy. These spongy masses continue through the ninth segment and into the tenth segment. In the latter half of the ninth segment tracheæ penetrate these spongy masses.

#### TRACHEAL SYSTEM.

There are two great dorsal longitudinal tracheæ, called right dorsal trachea, *rdt*, and left dorsal trachea, *ldt*, and two longitudinal lateral tracheæ, *rlt* and *llt*. In the anterior part of segment eight (Fig. 2), each lateral trachea gives off a visceral trachea, the right visceral trachea, *rvs*, and the left visceral trachea, *lvs*, respectively. These extend ventrad, mesad and cephalad in the seventh segment. For some distance there is no branching, but when the right visceral trachea and the left visceral trachea change their course somewhat and each takes up a lateral position a little farther forward, each begins to branch. The branches of the right visceral trachea supply the thickened epithelium on the right side of the alimentary canal, divide and subdivide and finally the smallest tracheoles shown in the diagram penetrate the epithelium. In like manner the branches of the left visceral trachea supply the thickened epithelium of the left side of the alimentary canal. The dorsal thickened epithelium is supplied by small tracheæ whose origin is from another branch of the left visceral trachea.

About the middle of the eighth segment each dorsal trachea gives off a branch, the right dorsal rectal trachea, *rdrt*, and the left dorsal

rectal trachea, *ldrt*<sub>1</sub>, respectively. Each of these runs mesad and caudad and enters the dorsal longitudinal fold of the alimentary canal (Fig. 1). Here these tracheæ divide and subdivide, but no anastomosis between the tracheoles of the right dorsal rectal trachea and the left dorsal rectal trachea was found.

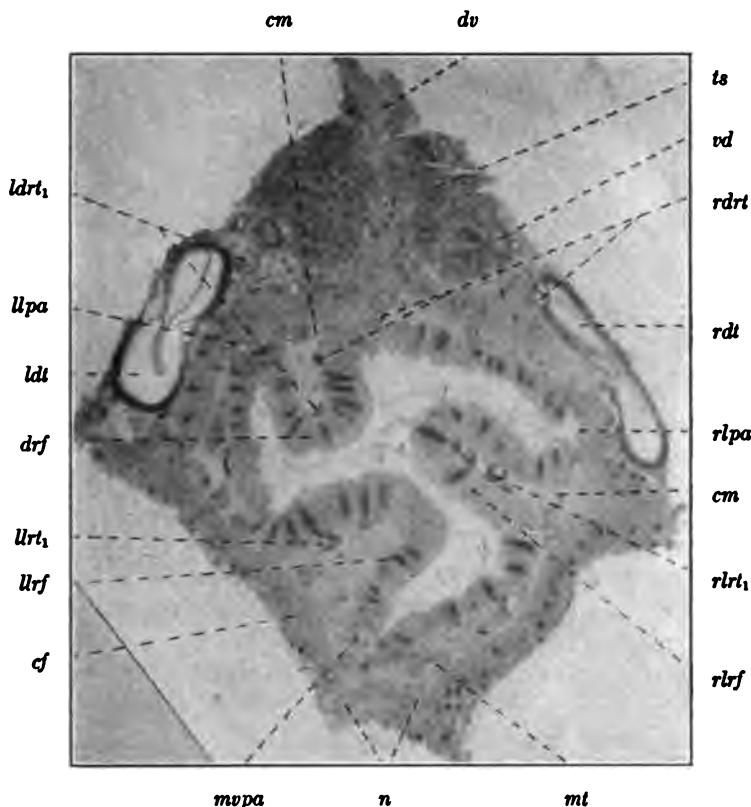


Fig. 1. Transverse section of abdomen of larva of *Argia moesta putrida* ♂ near the middle of the 7th segment (TS. 52, row 4, slide 3) seen from its posterior face. Cuticle and hypodermis removed before embedding. Photographed by Mr. H. A. Walters, using Leitz ocular 4, objective 3. Enlarged 117 diameters.

*cf*, connective tissue and fat.  
*cm*, circular muscles of gut wall.  
*drf*, dorsal rectal fold.  
*dv*, dorsal vessel.  
*ldrt*<sub>1</sub>, left dorsal rectal trachea.  
*ldt*, left dorsal trachea.  
*lpa*, left lateral pigmented area.  
*llrf*, left lateral rectal fold.  
*llrt*<sub>1</sub>, left lateral rectal trachea.  
*mt*, Malpighian tubule.

*mvpa*, mid-ventral pigmented area.  
*n*, nerve.  
*r*, rectum.  
*rdrt*, right dorsal rectal trachea.  
*rdt*, right dorsal trachea.  
*rlpa*, right lateral pigmented area.  
*rlrf*, right lateral rectal fold.  
*rlrt*<sub>1</sub>, right lateral rectal trachea.  
*ts*, testis.  
*vd*, vas deferens.

Some distance anterior to the origin of the dorsal rectal tracheæ there arises, on each side, the right lateral rectal trachea, *rlrt*<sub>1</sub>, and the left lateral rectal trachea *llrt*<sub>1</sub>, from the right visceral trachea and left visceral trachea respectively, at a point just mesad of the origin of each visceral trachea from the lateral trachea. The right lateral rectal trachea extends caudad and sends branches cephalad and caudad which enter the right longitudinal rectal fold. In like manner the left lateral rectal trachea supplies the left longitudinal rectal fold (Fig. 1).

Toward the end of the ninth segment a dorsal trachea appears, *ldrt*<sub>11</sub>. This originates from the left median caudal gill trachea, *lmcgt*, at the end of the ninth segment. It sends a branch caudad which penetrates the rectal epithelium in the anterior part of the tenth segment. Another branch extends cephalad giving off branches and penetrates the rectal epithelium about the middle of the ninth segment. No trachea corresponding to *ldrt*<sub>11</sub>, appears on the right side. Toward the end of the ninth segment small tracheæ are noticed in the spongy masses between the longitudinal folds of the rectum. The trachea in the ventral mass originates from a branch of the left lateral trachea at the hind end of the ninth segment. This little trachea extends mesad and cephalad and disappears in the ventral spongy mass about the middle of the ninth segment. The trachea of the left spongy mass originates at the end of the ninth segment from the left dorsal rectal trachea *ldrt*<sub>11</sub>. It runs cephalad a very short distance and disappears in the left spongy mass. The trachea of the right spongy mass originates at the end of the ninth segment from the right median caudal gill trachea, *rmcgt*. It extends mesad and cephalad a short distance in the right spongy mass where it disappears.

At the end of the ninth and the beginning of the tenth segment there is an anastomosis between the right and left lateral longitudinal tracheæ which meet in the midventral line. Two other tracheæ also take part in this anastomosis. These are a branch from the right and a branch from the left lateral caudal gill tracheæ, *rcgt* and *lcgt*, respectively.

"Observation and experiment with carmine particles on living larvae of *Argia moesta putrida* from the vicinity of Philadelphia showed that a larva watched for two hours may give no sign of rhythmic rectal contractions, but that these may suddenly begin and then continue for varying periods. They consisted of sets of three rapidly successive contractions, every third contraction being

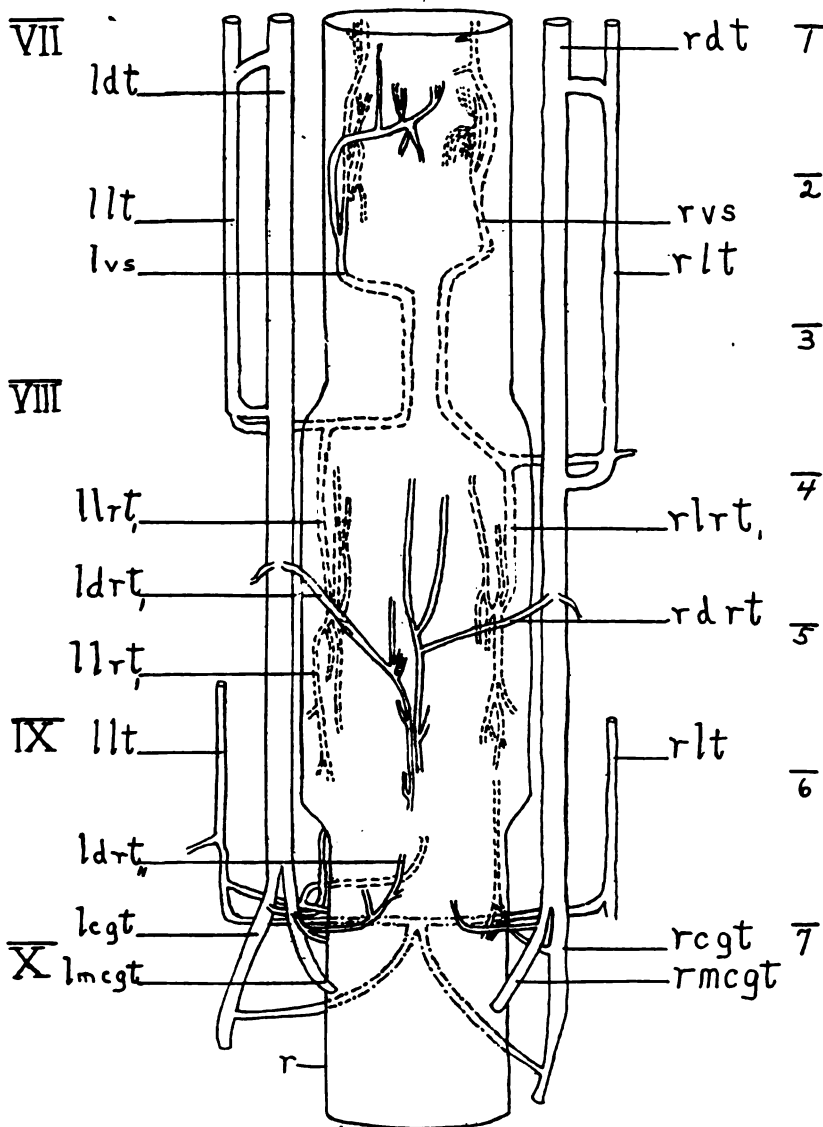


Fig. 2. Diagram of tracheation of the hind-gut of larva of *Argia moesta putrida*, reconstructed from sections. To avoid confusion the tracheæ are represented as lying farther to right and to left from the gut and from each other than is actually the case (compare Fig. 1). Of the tracheæ which supply the gut walls, those which run on the dorsal surface or enter the dorsal longitudinal fold are shown in solid lines; those which run on the ventral surface or enter the lateral folds are shown in broken lines. The tracheæ forming the ventral anastomosis are shown by alternating dots and dashes. The Roman numerals on the left side indicate the anterior ends of the respective abdominal segments, the Arabic numerals on the right the beginning of each row of sections on slide 3 of the series; each row comprises about 60 sections. Abbreviations as in Fig. 1, and as given in the text.

of longer duration than the other two; 32 such sets per minute were noted. At other times sets of five contractions were noted. In some larvae, but not in all, the beginning of a set of rectal contractions was often synchronous with a slight shortening of the abdomen; the lengthening of the abdomen began before the contractions had ended. A rhythmic shortening and lengthening of the abdomen may perhaps furnish an indication of the existence of rectal contractions in an opaque larva. Successive removal of the three caudal gills in one larva was not followed by any immediate beginning of rectal contractions, although such were seen four hours later; the larva was not under continuous observation during all of that time, however." (Calvert, *Ent. News*, XXVI, pp. 441-2.)

In the diagram of the rectal tracheation of *Thaumaloneura* larva figured by Calvert, Plate XVI, *Ent. News*, Vol. XXVI, there is one area of rectal respiration supplied by the right and left dorsal rectal tracheæ and the right and left lateral rectal tracheæ. It seems from the structure of *Argia putrida* larva that there may be two areas of respiration in the alimentary canal walls, a small one in segment seven and a larger respiration area in segments eight and nine. The respiration of the seventh segment may be carried on through the tracheæ supplied by the branches of the right and left visceral tracheæ. The larger respiration area of segments eight and nine is supplied with tracheæ through the branches of the right and left dorsal rectal tracheæ and the right and left lateral rectal tracheæ. In each case the structure of the epithelium of the alimentary canal appears to be the same. In the seventh segment, the three patches of thickened epithelium supply the surface through which respiration may take place. In the eight and ninth segments, the thickened epithelium of the longitudinal rectal folds supplies the surface through which respiration may take place (Fig. 1).

At the present time there is considerable doubt in the minds of observers as to the importance of these areas of respiration. When the caudal gills have been removed, the *Argia putrida* larva continues to live. Respiration may take place all over the surface of the body through the thin body wall. If this is the case, then we may assume that respiration also takes place throughout the length of the hind gut through its wall. The numerous tracheæ found penetrating the thickened epithelium can be explained as necessary because respiration is more difficult in these regions owing to the thickness of the walls, hence the many tracheoles penetrating the thickened epithelium. A comparison with the rectal respiration

areas of Anisopterid larvae seems to strengthen this view. In the rectal gills of these larvae, the minute branches of the tracheæ are separated from the water of the rectum by a very thin epithelium. This seems to show that respiration takes place most actively through a thin epithelium.

## II. THE TRACHEAL SUPPLY OF THE RECTUM OF THE LARVA OF ARGIA TALAMANCA FROM JUAN VIÑAS, COSTA RICA.

BY JANET P. JAMIESON.

The rectal epithelium of the water-fall dweller, *Argia talamanca*, presents three main longitudinal folds, one that is "dorsal and a little to the left of the median plane," a second that is "left latero-ventral" and the third that is "right lateral." These folds (Fig. 1.) correspond in position with those of the water-fall dweller *Thaumatoneura* described by Calvert (*Entomological News*, Vol. XXVI, p. 387, and plate XVII, fig. 1.) Those of *A. talamanca* are, however, deeper as may be seen by comparing photographs of the transverse sections, and show a greater complexity. In some parts of the rectum the free edges of the three folds appear to meet in the center of the lumen of the gut. Between the bases of these primary folds the epithelium thins out and becomes darkly pigmented. From the base of each primary fold, is given off a secondary shallower fold, to the right in the case of the dorsal fold, to the left in the case of the left latero-ventral fold and ventrally in the case of the right lateral fold.

Toward the hind end of the rectum the secondary folds disappear and the main folds have practically no depth; this gives an almost cylindrical shape to the hind part of the rectum.

The larva of *Argia putrida* from the vicinity of Philadelphia, described in the preceding paper by Miss Cullen, differing from *A. talamanca* in that it lives in streams of continuously flowing water, shows three simple shallow folds in the rectal epithelium, one dorsal, one right lateral and one left lateral. The epithelium is much denser and thicker than in this water-fall dweller of the same genus, and the thin pigmented areas between the bases of the folds are not so broad.

It has been suggested by Calvert that the more extensive surface area afforded by the greater folding of the rectum together with the thinner, less dense nature of the epithelium of the water-fall dwellers may aid these larvae materially in procuring a supply of

oxygen from the rectum that supplements the supply obtained by the gills when the larva is in the water. The caudal gills of *A. talamanca* are much shorter than those of *A. putrida*. This suggests that there may be a definite ratio between the shortness of the gills and the complexity of the rectal epithelial folds. This theory is strengthened by the fact that Anisopterous larvæ, as described

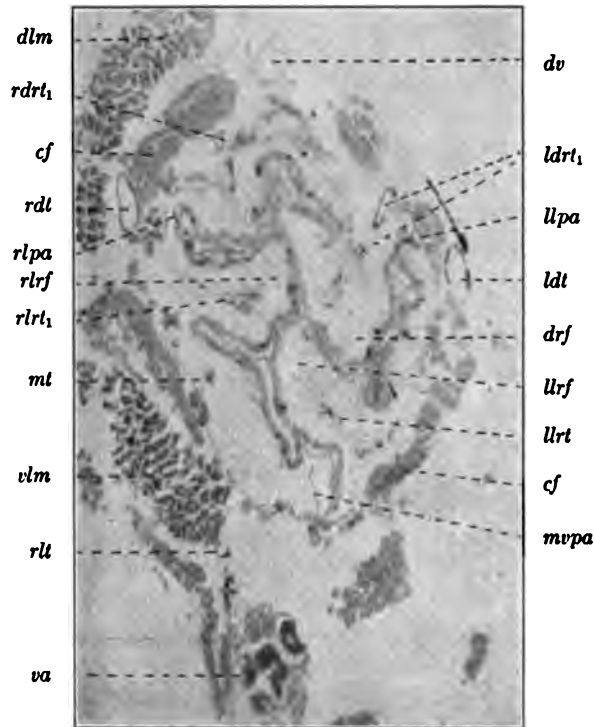


Fig. 1. Transverse section of abdominal organs of larva of *Argia talamanca* ♀ near the hind end of the 8th segment (TS. 12 of row 6, slide 2), seen from its anterior face. Cuticle and hypodermis removed before embedding, also on the left side (right in the figure) the longitudinal muscles. Photographed by Mr. H. A. Walters, using Leitz ocular 4, objective 3. Enlarged 85 diameters.

*cf*, connective tissue and fat.  
*dlm*, dorsal longitudinal muscle.  
*drf*, dorsal rectal fold.  
*dv*, dorsal vessel.  
*ldrt<sub>1</sub>*, left dorsal rectal trachea.  
*ldt*, left dorsal trachea.  
*llpa*, left lateral pigmented area.  
*llrf*, left latero-ventral rectal fold.  
*llrt*, left lateral rectal trachea.  
*lll*, left lateral trachea (lies outside of the field of this figure).

*ml*, Malpighian tubule.  
*mvpa*, mid-ventral pigmented area.  
*r*, rectum.  
*rdrt<sub>1</sub>*, right dorsal rectal trachea.  
*rlpa*, right lateral pigmented area.  
*rlrf*, right lateral rectal fold.  
*rlrt<sub>1</sub>*, right lateral rectal trachea.  
*rdt*, right dorsal trachea.  
*rll*, right lateral trachea.  
*va*, vagina.  
*vlm*, ventral longitudinal muscle.

by Tillyard (*Proceedings of the Linnean Society of New South Wales*, 1915, Vol. XL, Part 3, August 25), have a much greater folding of the rectal epithelium and no caudal gills. To quote him: The rectum presents "six longitudinal double rows of lamellate folds." It is within the thicker, unpigmented portion of the rectal epithelium of *A. talamanca* that the fine ends of the tracheoles which reach the epithelium are embedded. Though the number of these embedded tracheoles is small, numerous tracheæ were traced into the folds and almost to the epithelium. This would suggest that diffusion of oxygen takes place more easily through the unpigmented portions of the folds. The secondary folds increase the diffusion area. The fact that no tracheoles were traced through or even up to the pigmented epithelium between the folds suggests that these areas are reserved for the osmosis of carbonic acid gas from the body tissues into the rectum. For says Tillyard, "It is well known . . . that chitin is a colloid substance which admits of the passage through it of gases by diffusion, and is particularly partial to carbonic acid gas."

The absence of folding of the epithelium at the extreme end of the rectum probably merely facilitates the quick and constant flow of water.

*The rectal tracheæ.*—The tracheæ that supply the rectum of *A. talamanca* have been studied from a series of transverse sections prepared by and in the possession of Dr. Calvert. Owing to the decay of the anterior rectal epithelium some smaller tracheoles may have been lost.

Two main dorsal longitudinal tracheæ have been traced, one on the left (*ldt* of figs. 1 and 2), the other on the right (*rdt*).

These divide at the posterior end of the ninth segment respectively into the left caudal gill trachea (*lcgt*) and left median caudal gill trachea (*lmcgt*) and into the right caudal gill trachea (*rcgt*) and the right median caudal gill trachea (*rmcgt*).

Within the posterior half of segment VIII arise from the longitudinal dorsal tracheæ, a right dorsal rectal trachea (*rdrt<sub>1</sub>*) and a left dorsal rectal trachea (*ldrt<sub>1</sub>*), both of which pass mesad and caudad into the dorsal longitudinal rectal fold where they divide and subdivide. Some of the smaller tracheoles enter the epithelium, but no anastomoses were observed.

From the lateral tracheæ (*rlt* and *llt*), which are connected with the dorsal longitudinal trunks in the middle of segment VIII, there come off ventrally in the anterior half of segment VIII, the lateral



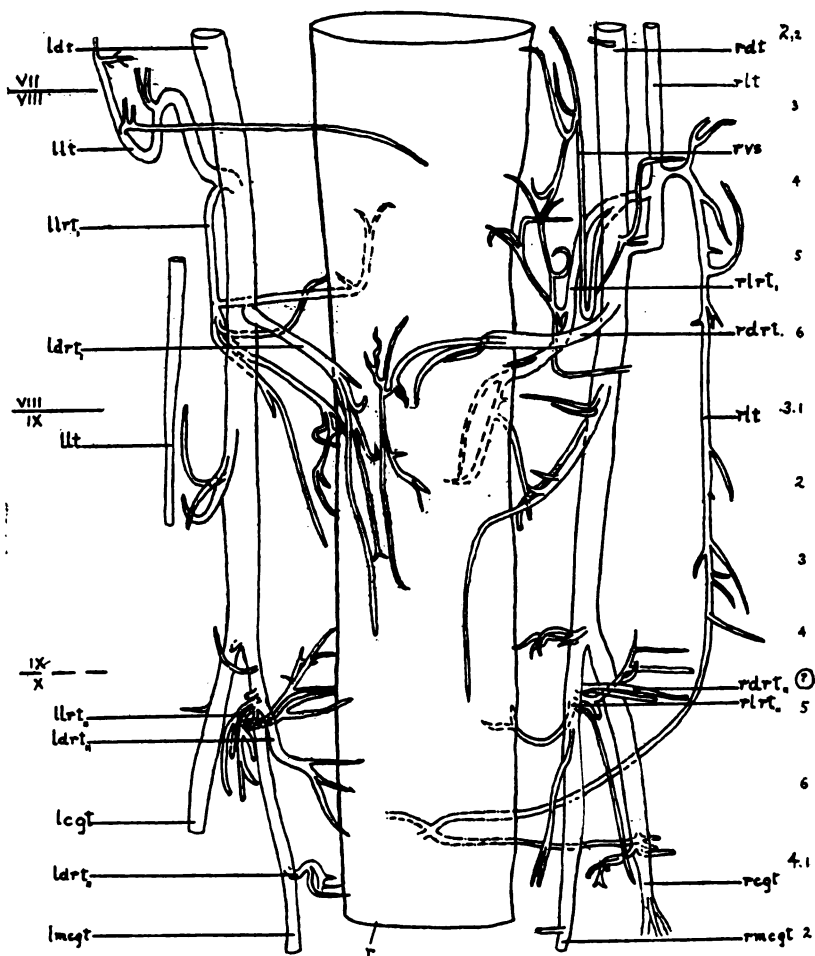


Fig. 2. Diagram of the tracheation of the rectum of larva of *Argia talamanca*, reconstructed from sections. To avoid confusion the tracheæ are represented as lying farther to right and to left from the gut and from each other than is actually the case (compare Fig. 1). Of the tracheæ which supply the gut walls, those which run on the dorsal surface or enter the dorsal longitudinal fold are shown in solid lines; those which run on the ventral surface or enter the lateral folds are shown in broken lines. The ventral anastomosis is shown in dots and dashes. The Roman numerals on the left side indicate the boundaries of the respective abdominal segments; the larger Arabic numerals on the right, the microscopic slides and the smaller Arabic numerals the rows of sections on each slide of the series corresponding to that part of the diagram represented as at the same horizontal level. Each row comprises about 30 sections. Abbreviations as in Figure 1 and as explained in the text.

rectal tracheæ (*rlrt<sub>1</sub>* and *llrt<sub>1</sub>*). Each of these passes mesad and caudad and enters the lateral longitudinal rectal fold of its respective side. The origin of the right lateral rectal trachea differs slightly from that of *Thaumatooneura* as worked out by Calvert. Subdivision of these tracheæ occurs and some of the tracheoles enter the epithelium. No anastomosis has been found here. A smaller posterior rectal supply (*llrt<sub>11</sub>* and *rlrt<sub>11</sub>*), is received by the lateral rectal folds from the left and right median caudal gill tracheæ respectively. Some of these tracheoles also enter the epithelium, but no anastomosis occurs.

A small posterior dorsal supply (*ldrt<sub>11</sub>*) is received by the dorsal longitudinal fold and by the epithelium from the left median caudal gill trachea. The corresponding (?) group on the right has been traced laterad through and around the muscle fiber mass toward the periphery of the body.

The last two paragraphs show slight differences between *Thaumatooneura* and *Argia talamanca*.

Calvert's statement for *Thaumatooneura* may be quoted here for *A. talamanca*. "The only anastomosing tracheæ which have been discovered are the posterior terminations of the right and left (?) lateral longitudinal tracheæ which, assuming a ventral position, meet on the mid-ventral line ventrad of the alimentary canal; in this anastomosis (*anas*) take part also a branch from the right and a branch from the left (?) lateral caudal gill trachea." The interrogation marks signify an incomplete tracing in *Argia talamanca* due to maceration of parts of the anastomosing tracheæ from the left side.

I think I may say that *all* the tracheæ, large and small, that were traced possessed a black pigment that added materially to the ease of tracing. As has been observed for *Thaumatooneura*, this pigment presents the same appearance as that of the areas between the three longitudinal folds of the rectal epithelium.

For material, directions and suggestions in my work I am indebted to Dr. P. P. Calvert, whose treatment of *Thaumatooneura* I have followed for *Argia talamanca*. The sections studied were of "larva No. 2," ♀, from the "nearer waterfall," Juan Viñas, Costa Rica, March 23-26, 1910, which died in attempted rearing; its condition is, therefore, histologically poor. The locality has been described by Calvert in his *Thaumatooneura* paper cited.

### III. THE HIND-GUT, ABDOMINAL TRACHEÆ AND RECTAL RESPIRATION IN THE LARVA OF *MECISTOGASTER MODESTUS* FROM COSTA RICA.

BY MITCHEL CARROLL.

The abdominal viscera, including the rectum, of *Mecistogaster modestus* have been described by Calvert (1911 *b*, p. 452) from a dissection of larva No. 1 (male).

The slides for the following study were loaned by Dr. Calvert from his personal collection. They contain the serial transverse sections of the last five abdominal segments and bases of the median and right caudal gills of female larva No. 3. This larva was one of those obtained by Dr. Calvert from the water collected between the bases of the leaves of a Bromeliad at Juan Viñas, Costa Rica, April 26, 1910 (1911 *a*, pp. 407-408). It was killed in hot water and preserved in alcohol. Before sectioning the chitinous cuticle was removed from the abdominal segments. The stains used were Delafield's hæmatoxylin and alcoholic eosin. The sections were cut .015 mm. thick.

#### THE HIND-GUT.

The hind-gut may be divided into six distinct parts. A brief description of these divisions is given below.

The Malpighian tubes are attached to the gut at the junction of segments VI and VII., (Calvert, 1911 *b*, Plate XVII, Fig. 8). From this point caudad to section 35 there are twelve longitudinal folds in the epithelium lining the lumen of the gut. The position of these, adopting the "Clock Face Notation" of Tillyard (1916, p. 132), is 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12, where the larger figures indicate longer folds, the small figures shorter folds (Fig. 1 of sect. 20).

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All the figures accompanying this paper are of the larva of *Mecistogaster modestus* Selys.

The photographs reproduced in Figures 1-5, were made by Mr. H. A. Walters, using Leitz ocular 4, objective 3. They represent the posterior surfaces of the several sections.

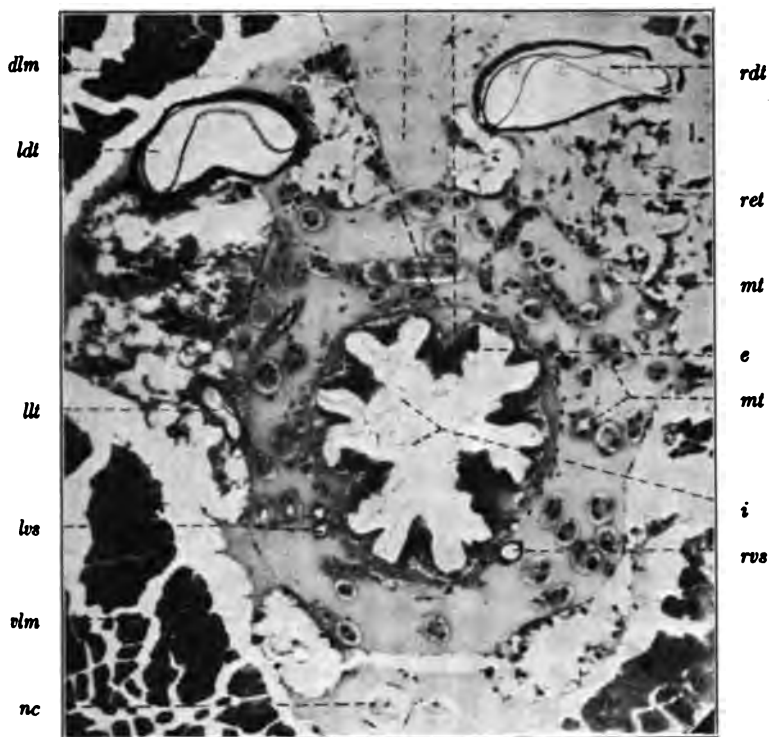
Fig. 1. Part of photograph of transverse section 20 (Short Intestine). Enlarged 142 diameters.

- |  |  |
|--|--|
| <i>b</i> , basement membrane.  | <i>lm</i> , bands of longitudinal muscle.  |
| <i>cm</i> , circular muscle coat of the gut.                                     | <i>mt</i> , Malpighian tubule.             |
| <i>dln</i> , dorsal longitudinal muscle.   | <i>nc</i> , nerve cord.                    |
| <i>dv</i> , dorsal vessel.   | <i>pe</i> , pigmented epithelium.          |
| <i>e</i> , epithelial layer.   | <i>rad</i> , radial muscle strands.        |
| <i>f</i> , longitudinal epithelial fold projecting caudad into a pouch (Fig. 3). | <i>ret</i> , reticulate connective tissue. |
| <i>i</i> , chitinous intima.   | <i>vlm</i> , ventral longitudinal muscle.  |

Tracheæ as in Figure 6.

Fig. 2. Part of photograph of transverse section 55 (Prerectal Ampulla). Enlarged 100 diameters. Abbreviations as in Figure 1.

cm dv b



This part of the hind-gut, from about section 1 to section 35, anterior part of segment VII (Fig. 6), seems to be homologous with the ileum or small intestine of the Orthoptera (Minot, 1880, pp. 209, 217; Packard, 1898, pp. 316, 317; Bordas, 1898, pp. 48 and 52), and with the small intestine of Anisopterous larvæ (Sadones, 1895, pp. 277, 279, 291; Faussek, 1887, p. 708; Tillyard, 1916, p. 131). In his recent book on the Dragonflies (Tillyard, 1917, pp. 101, 113, 114) Tillyard calls this division of the hind-gut the short intestine; but there is present here no ventral pad of thick columnar epithelium as described by that author and Sadones. In Fig. 1 of sect. 20, we have from within outward: the chitinous intima, *i*; the epithelial layer, *e*; the basement membrane, *b*; and the circular muscular coat, *cm*. The cells of the epithelial layer are not all of the same size. The largest are those of the apical portions of the longer folds. Here the cells are elongate and, in the transverse sections of the ileum, appear somewhat wedge-shaped, with the bases of the wedges next the intima. In the shorter folds, and in the furrows between the folds, the cells are much flatter. The basement membrane follows the folds of the epithelium mesad, leaving, as a result, triedral spaces between itself and the circular muscle coat; these spaces are filled with blood.

Just posterior to section 20 (Fig. 1 and 6, row 4 of slide 1), three (Nos. 4, 8, and 12) of the above six large folds gradually broaden out, become flatter, and transform into the three broad longitudinal bands of thick columnar epithelium seen at section 55 (Fig. 2, row 5 of slide 1). The other nine folds, 1. 2. 3—5. 6. 7—9. 10. 11, consisting of the epithelium mentioned in the preceding paragraph, are also present at this point. Figure 2 represents the appearance of the hind-gut between sections 35 and 80. It is probably homologous with the prerectal ampulla of some Orthoptera (Bordas, 1898, pp. 52, 48) and of Anisopterous larvæ (Sadones, 1895, pp. 280, 295; Tillyard, 1916, Plate 31). Sadones describes two broad bands of thick epithelium separated from one another by folds of a different kind of thin epithelium, in the prerectal ampulla of the larva of *Libellula depressa*. Tillyard's description of this section of the gut agrees with that of Sadones (Tillyard, 1917, pp. 101, 113, 114). The diameter of the gut, too, is here greater than in the parts of the digestive tube immediately preceding and following. But both Sadones and Faussek (1887, pp. 708, 709) state that two kinds of epithelia also occur in the ileum of Anisopterous larvæ. Faussek, indeed, does not mention the occurrence of a prerectal ampulla in Aeschnid larvæ.

Whatever be the true homology of this portion of the gut, it is clearly differentiated from the preceding and following divisions of the alimentary canal by the presence of the three bands of thick columnar epithelium. Histologically this columnar epithelium appears similar to the longitudinal folds of columnar epithelium found further caudad, in the rectal part of the hind-gut. The three bands of columnar epithelium referred to in this, and the preceding paragraph, extend from about section 35 or 40 to section 80 (Fig. 6), that is, through about the middle third or fourth of segment VII. In Fig. 2, in addition to the parts already discussed, we see the intima, *i*, basement membrane, *b*, circular muscular coat, *cm*, and the bands of longitudinal muscle, *lm*. There are six of the latter, but they are not all visible in the photograph. They are located outside the circular muscles, near the bases of the folds, 1, 3, 5, 7, 9, 11. The musculature of the posterior intestine of *Mecistogaster* seems to be similar to that of the insects described by the authors mentioned in this paper.

Caudad to section 80 the gut narrows and the three bands of columnar epithelium gradually assume again the appearance they had cephalad to section 35. That is, the epithelium of these folds becomes indistinguishable histologically from that of the other folds. Indeed, in transverse section, the gut has much the same appearance posterior to section 80 that it has anterior to section 35 (Fig. 1). This portion of the gut, from about section 80 to section 140 (Fig. 6), may correspond to the colon of some Orthoptera (Minot, 1880, pp. 209, 217). Or (which is unlikely), if the portion of the digestive tube immediately following this, instead of the one immediately preceding, is homologous with the prerectal ampulla of Anisopterous larvæ (Sadones, pp. 280, 295), this is homologous with the small intestine of Anisopterous larvæ (Sadones, p. 279; Tillyard, p. 131; Faussek, pp. 708, 709).

At section 110 (Fig. 6), posterior part of segment VII, there are six large folds (Nos. 2, 4, 6, 8, 10, 12), which practically fill the lumen of the gut.

At section 140 the above folds have decreased in size and the gut has become pouched. This pouching increases greatly the diameter of the lumen so that from sections 150 to 160 (Fig. 3 of sec. 150) it is relatively very wide. The longitudinal epithelial folds project caudad into these pouches for some distance. It may be that this pouched portion of the intestine is homologous with the prerectal ampulla of some Orthoptera (Bordas, 1898, pp. 48, 52) and Ani-

sophterous larvæ (Sadones, 1895, pp. 280, 295; Tillyard, 1916, p. 131 and 1917, pp. 101, 113, 114), but the character of the epithelium does not correspond to that described by Tillyard and Sadones. The latter describes and figures two lateral plates of thick epithelium separated from one another by numerous folds of thin epithelium. In this portion of the *Mecistogaster* intestine there is only one kind of epithelium. In the larva under discussion it is not very well preserved, but seems to be similar to that already described as occurring in the first and third divisions of the hind-gut. Then, too, there is no narrowing or constriction of the intestine posterior to this pouched or cæcal region as in the other insects mentioned above; the pouched region passes without any very apparent change in diameter into the rectum.

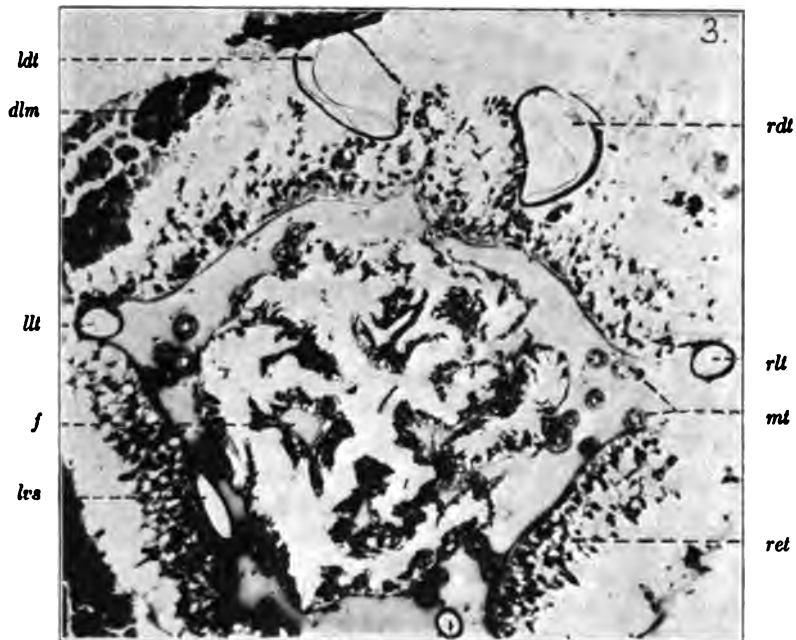
In the diagram (Fig. 6), the gut between sections 50 and 80 (the part which, as has been suggested, is probably homologous with the prerectal ampulla of other insects) is seen to be supplied with branches from the left and right visceral tracheæ (*lvs*, *rvs*). Some of these tracheoles end just within and some just without, the basement membrane of the large columnar cells of the three broad folds (4, 8 and 12) or bands referred to above. The mid-dorsal (12) and the left ventro-lateral (8) folds are supplied by tracheoles from the left visceral trachea (*lvs*); the right ventro-lateral fold (4) is supplied by branches from the right visceral trachea (*rvs*). No tracheoles have been found penetrating any of the other folds of the gut epithelium thus far mentioned.

The next, or fifth, division of the posterior intestine is the rectum proper. (Minot, 1880, pp. 209, 210, 218; Packard, p. 318; Tillyard, 1916, pp. 131, 140-189 and 1917, pp. 101, 114, 115, 116; Sadones, 1895, pp. 277, 280, 294-315; Faussek, 1887, pp. 708-711; Bordas, 1898, pp. 48, 52.) In Anisopterous larvæ it is this region which functions as the branchial basket (Tillyard). In *Mecistogaster* there is, of course, nothing corresponding to a branchial basket. The so-called rectal glands, which Tillyard (1916, pp. 179-189) has shown to be homologous with the rectal gills, are represented by three broad longitudinal folds of thick columnar epithelium (Fig. 4 of sect. 250), instead of six as in Anisopterous larvæ. These folds occupy the same relative positions (Nos. 4, 8 and 12, of the

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Fig. 3. Part of photograph of transverse section 150 (Pouched Part of the Rectum). Enlarged 115 diameters. Abbreviations as in Figure 1.

Fig. 4. Part of photograph of transverse section 250 (Rectum). Enlarged 114 diameters. Abbreviations as in Figure 1.





"Clock Face Notation") as the three folds of columnar epithelium seen from sections 40 to 80 (Figs. 6 and 2). Histologically, too, the epithelia of the folds 4, 8 and 12 of these two portions of the gut appear similar. These folds have been described by Calvert in the larva of this species (1911 b, p. 452, Plate XVII, Fig. 10).

The rectum extends from about section 160 to section 380 (Fig. 6), that is, through nearly all of segment VIII, all of segment IX, and the anterior fourth of segment X. Figure 4 represents the appearance of the rectum from section 200 to section 300. From within outward can be seen: the chitinous intima, *i*; the folds of columnar epithelium, *e*; the basement membrane, *b*; the non-continuous circular muscular coat, *cm*; and the longitudinal strands of muscle, *lm*. (These last are located at the positions 1, 3, 5, 7, 9, 11, of the clock face notation, but do not stand out very clearly in the photograph). Spaces between the basement membrane and the circular muscle coat are filled with blood, and Malpighian tubules also extend into them, *e.g.*, in TS. 315, 319, 324, 327, 342, etc. In this part of the rectum almost the entire lining of the gut consists of the epithelium of the three longitudinal folds. The latter are, however, separated by three small pigmented areas (Fig. 4). These are the "non-cellular" bands described by Calvert in larva No. 1, (1911 b, p. 452, Plate XVII, Fig. 10). I have examined the original slide containing the rectum of larva No. 1 and found no trace of cells or nuclei in these three areas. In Fig. 4, one of these pigmented bands (*mupa*) is seen to be midventral, the other two (*rlpa* and *llpa*) are dorso-lateral in position. At section 320, where the longitudinal folds 2, 6, 10 begin to appear in the pigmented bands, the cellular nature of these areas becomes somewhat more apparent. (Compare Cullen, 1918, fig. 1, and Jamieson, 1918, fig. 1.)

*Mecistogaster* larva No. 1, described by Calvert, was older than No. 3, the subject of this paper. Whether the age of the larva has anything to do with the presence or absence of epithelial cells in the pigmented rectal bands I am unable to say. It does not seem likely that it is a matter of fixation as larvæ No. 1, 2, and 3 were all fixed in the same way (hot water) and at the same time.

The three broad folds of the rectal epithelium and the three small pigmented areas mentioned in the two preceding paragraphs are homologous with similar folds and areas in the rectum of *Thaumatonoura* (Calvert, 1915, p. 387) and *Argia* (Cullen, 1918, p. 77, Fig. 1). The folds are, however, much shallower than in *Thaumatonoura* (Calvert, 1915, Plate XVII, Fig. 1) and *Argia talamanca* (Jamieson, 1918,

p. 82, Fig. 1). They resemble more the folds seen in *Argia moesta putrida* (Cullen, l.c.) The epithelium, too, is much thicker ( $41$  to  $83\ \mu$ ) in *Mecistogaster modestus* than in the first two larvæ named above, resembling more *Argia moesta putrida* in this respect also. But on slide 7 of *Thaumatoneura* larva No. 7 (female, Dr. Calvert's personal collection), I found sections where the epithelium of the rectal folds, was about as thick ( $50$  or  $60\ \mu$ ) as that of the corresponding region in *Mecistogaster*.<sup>1</sup>

About section 310 (Fig. 6) the three folds (4, 8, 12) of thick columnar epithelium begin to occupy less, and the pigmented areas separating them more, of the gut wall. At section 370 the folds (or rather bands, for they are no longer folds) of columnar epithelium have contracted so as to form only about half of the gut wall. The epithelium of these bands has, however, become much thicker ( $83\ \mu$ ) than further cephalad. Between these bands are seen three folds (Nos. 2, 6 and 10) of spongy or reticulate connective tissue covered on the lumen side by the more or less broken down epithelium of the pigmented areas mentioned above. While spaces filled with blood and an occasional Malpighian tubule exist between the basement membrane of folds 4, 8 and 12 and the circular muscle coat, the circular muscle fibres are in contact with the spongy tissue of folds 2, 6 and 10.

Folds of spongy tissue, homologous to those in *Mecistogaster*, occur in the rectum of *Thaumatoneura* larva. On slide 7 of *Thaumatoneura* larva No. 7, female, (Dr. Calvert's collection), there are three such folds of reticulate tissue covered by a pigmented epithelium.

About section 373 (Fig. 6) some of the spongy tissue extends out into the hæmocele.

From section 383 (Fig. 6), anterior part of segment X, caudad to the end of the gut no more is seen of the large columnar cells of the longitudinal folds. This region, from about section 380 to the end of the gut, corresponds to the vestibule or anal part of the rectum of Anisopterous larvæ (Sadones, 1895, pp. 277, 280, 315; Tillyard, 1916, p. 131 and 1917, pp. 101, 114, 115, 116; Faussek, 1887, p. 45). But there are not two kinds of epithelia as described by Sadones for *Libellula depressa*, nor is there any indication of a

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<sup>1</sup> As the larvæ of *Thaumatoneura* and of *Argia talamanca* figured in the papers above cited were unavoidably those which died in attempted rearing, it is perhaps not impossible that the thinness of their epithelia may be a starvation effect.—P. P. CALVERT.)

stratification of the epithelium as mentioned by that author (Sadones, Fig. 49). The epithelium covering the six longitudinal folds, although it is not as well preserved in this region as one would wish, seems to consist of a single layer of elongate cells. These, except for the presence of more pigment, are similar to those described for the folds of the first part of the hind-gut. The musculature of the anal part of the *Mecistogaster* intestine is homologous, as is pointed out below, to the musculature of the corresponding region in Anisopterous larvæ.

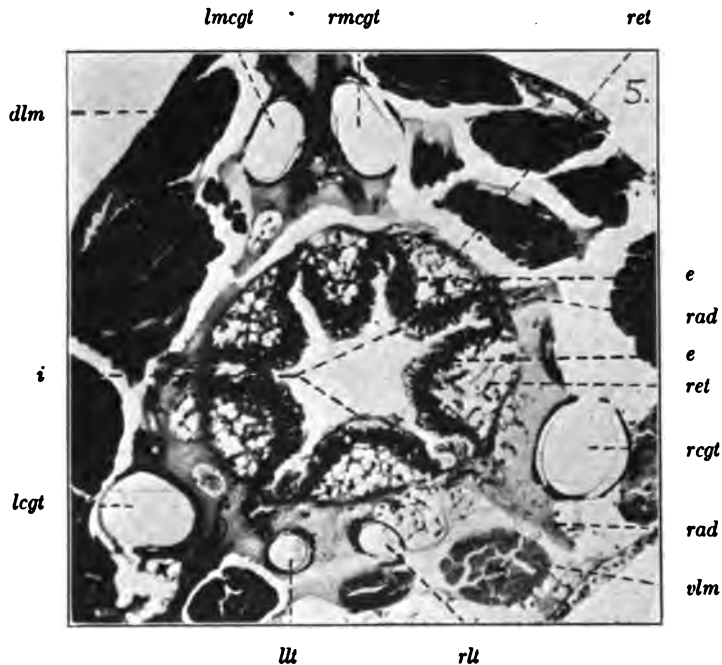


Fig. 5. Part of photograph of transverse section 393 (Anal Part, or Vestibule, of the Rectum). Enlarged 125 diameters. Abbreviations as in Figure 1.

Figure 5 is a photograph of section 393. It illustrates the appearance of this sixth and last division of the hind-gut. In section 393 the following parts can be made out: intima, *i*; pigmented epithelium of the six longitudinal folds, *e* (the epithelium of folds 2, 6 and 10 is continuous with the more or less disintegrated epithelium of the pigmented areas of the preceding division of the gut); basement membrane, *b*; reticulate connective tissue, *ret*; circular muscle layer, *cm*; and the radial muscle strands, *rad*.

*Summary of the Divisions of the Hind-Gut, with Homologies.*

	PART	HOMOLOGIES	TEXT FIGURE	FOLDS	LOCATION
Small Intestine or Ileum (Tillyard, 1917, pp. 101, 113, 114).	1.	Ileum (Orthoptera) Short Intestine (Anisoptera).	Fig. 1	12 folds (Nos. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12).	Anterior part segment VII Sections 1-35.
	2.	Prerectal Ampulla (Anisoptera, some Orthoptera).	Fig. 2	3 folds of thick columnar epithelium (Nos. 4, 8, 12) and 9 other folds (Nos. 1. 2. 3—5. 6. 7—9. 10. 11).	Middle part segment VII Sections 35-80.
	3.	Colon (some Orthoptera).	(Not figured, similar to Fig. 1)	12 folds (Nos. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12).	Posterior part segment VII Sections 80-140.
Rectum (Tillyard, 1917, pp. 101, 114, 115, 116).	4.	Pouched Region (no reference to such a region found in the literature).	Fig. 3		Anterior part segment VIII Sections 140-160.
	5.	Anterior part of Rectum (most insects) Branchial Basket (Anisoptera).	Fig. 4	3 folds (Nos. 4, 8, 12) of thick columnar epithelium. Toward posterior end folds 2, 6 and 10 are also present.	Segments VIII, IX, X Sections 160-380.
	6.	Anal part of Rectum; Vestibule (Anisoptera).	Fig. 5	6 folds (Nos. 2, 4, 6, 8, 10, 12).	Segment X Section 380 to anus.

There are six of the radial muscle strands. They connect with the rectum at the points 1, 3, 5, 7, 9, 11, of the clock notation as described by Tillyard. Radiating outward they are attached at their peripheral ends to the body wall. They correspond to the radial rectal dilator muscles of Anisopterous larvæ (Tillyard, 1916, pp. 139, 140; Sadones, 1895, p. 316).

As indicated in the above table, Tillyard in his recent excellent book, *The Biology of Dragonflies* (1917, pp. 101, 113, 114, 115, 116), divides the hind-gut of Odonate larvæ into two main parts, the small intestine or ileum and the rectum. The small intestine is subdivided into the short intestine and prerectal ampulla. The first two divisions of the hind-gut in the present larva are evidently homologous with these two parts. But histologically the structure of this part of the intestine in *Mecistogaster* differs from the description given by Tillyard or the other authors mentioned above. The third division of the small intestine, which is called the colon in the table, is not described by Tillyard.

Tillyard's statement (1917, footnote, p. 101) that "in Zygopterid larvæ the rectum is undivided," is hardly true for *Mecistogaster*. In the present larva, as indicated in the above table and described on preceding pages, the rectum (as the term is used by Tillyard) is divided into three distinct regions. These differ from one another both in gross morphology and finer histological structure.

#### THE TRACHEÆ (Fig. 6).

In the diagram (Fig. 6), in order to represent more clearly the main trunks with their branches, most of the tracheæ have been drawn far laterad to their true position. The correct orientation may be obtained by referring to the photographs of the transverse sections (Figs. 1, 2, 3, 4, 5). The diameters of the tracheæ and gut have been drawn on a scale twice as great as their length. A glance at Fig. 4, of section 250, shows that the rectum is slightly asymmetrical with respect to the epithelial folds of the gut wall. By comparing the mid-dorsal fold (No. 12) with the same fold in *Thaumaloneura* larva (Calvert, 1915, Plate XVII) it was possible to determine the true right and left sides. The latter are correctly represented in the diagram, Fig. 6, showing the distribution of the abdominal tracheæ as seen from the dorsal side.

From the anterior part of segment VII (Fig. 6) the two great dorsal longitudinal trunks (*rdl*, *ldl*) run caudad, dorso-lateral to the gut, as far as sections 40 and 60 respectively. At these points

transverse connectives (*dlc*) are given off to the lateral longitudinal tracheæ (*lll*, *rlt*). From about sections 95 to 130 the dorsal trunks are almost in contact with one another and lie dorsal to the gut. At about section 170 on the right, and 180 on the left, two more transverse connectives (*dlc*) connect the dorsal and lateral longitudinal trunks. At section 190 the dorsal tracheæ have moved out laterally and are entirely lateral at section 240 (Fig. 4 of section 250, *ldt* and *rdt*), where they lie on opposite sides of the gut. The anterior or chief left (*ldrt*<sub>1</sub>) and right (*rdrt*<sub>1</sub>) dorsal rectal tracheæ are given off from the dorsal longitudinal trunks about section 250, posterior part of segment VIII. These dorsal rectal tracheæ run mesad and supply the columnar epithelium of the dorsal rectal longitudinal fold (No. 12), (Figs. 4, and 6, *ldrt*<sub>1</sub> and *rdrt*<sub>1</sub>). By the time they have reached section 260, posterior end of segment VIII, the dorsal trunks are really ventro-lateral in position with respect to the gut. At section 320 they are again dorso-lateral in position, and at section 328, caudad to the middle of segment IX, they divide into the median (*lmcgt*, *rmcgt*) and lateral (*lcgt*, *rcgt*) caudal gill tracheæ (Figs. 5 and 6). The lateral gill tracheæ pass to the ventral side of the gut and thence into the lateral gills.

From the left median caudal gill trachea (*lmcgt*) small branches (*ldrt*<sub>11</sub>) are given off to the dorsal rectal fold at section 345, segment IX, and section 362, segment X. About section 352 a small branch (*llrt*<sub>11</sub>) is given off to the left ventro-lateral rectal fold.

From the right median caudal gill trachea (*rmcgt*) a branch (*rlrt*<sub>11</sub>) is given off to the right ventro-lateral rectal fold at section 356. Two other small branches whose course could not be followed, are also given off at about this point.

In the anterior part of segment VII the lateral longitudinal tracheæ (*lll*, *rlt*) lie on opposite sides of the gut, beneath the dorsal trunks (Figs. 1 and 6). They remain lateral in position as far as section 180, anterior part of segment VIII. A little caudad to this they pass between the hypodermis and the ventro-lateral muscle masses to the ventral side of the abdomen. They run thence caudad beneath the gut (Figs. 6 and 4, *lll*, *rlt*), but never in contact with it and giving off no branches to it, to section 373, segment X. Here the right lateral longitudinal trachea (*rlt*) passes over to the left side and joins (section 388) the left lateral longitudinal trachea (*lll*), forming an anastomosis (*anas*); separating again almost immediately after (section 391, Fig. 5), they join respectively tracheæ *rcgt* and *lcgt*.

Closed spiracles (Fig. 6, *Sp. 7*) connect with the lateral longitudinal tracheæ (*rlt*, *llt*) at sections 45-49 and 60, segment VII, where the dorsal lateral connectives (*dlc*) are given off to the dorsal longitudinal trunks (*ldt*, *rdt*). There are closed spiracles (*Sp. 8*) also at the corresponding points on the lateral tracheæ in segment VIII, sections 165 and 171. But in addition to the dorsal lateral connectives, there originate here the tracheæ which bifurcate at about section 190 to form the right (*rvs*) and left (*lvs*) visceral tracheæ, and the right (*rlrt<sub>1</sub>*) and left (*llrt<sub>1</sub>*) lateral rectal tracheæ. The latter may be considered as prolongations caudad of the visceral tracheæ (Figs. 6 and 4).

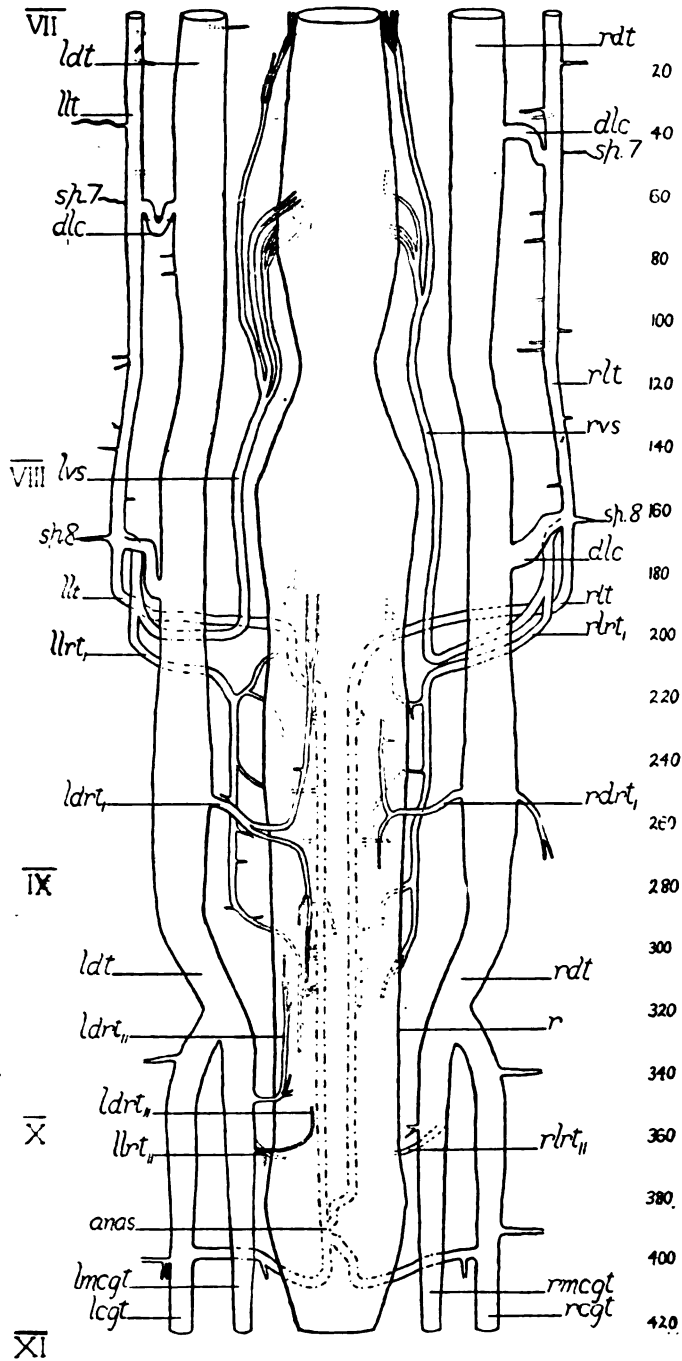
The left visceral trachea (*lvs*), as shown in Fig. 6, runs cephalad as far as section 1, anterior end of segment VII. Between sections 190 and 155 it lies ventrad to, but not in contact with the gut (Fig. 3, *lvs*); anterior to section 155 it assumes a lateral position (Fig. 1). At section 120 the main trachea divides into three branches. One of these supplies the left ventro-lateral fold (No. 8) of columnar epithelium (Sect. 60). The third branch runs forward to the

Fig. 6. Diagram of the hind-gut and rectal tracheæ. The abdominal segments are numbered in Roman numerals on the left side of the figure, the microtome sections are numbered in Arabic on the right. The sections are numbered in order (1-420) beginning at the anterior end of the hind-gut (anterior end of segment VII) and proceeding caudad to the posterior end of segment X. The short horizontal lines immediately above the Roman numerals indicate the approximate boundaries of the segments. The meanings of the abbreviations designating the tracheæ are given below.

Those portions of the lateral longitudinal tracheæ which lie ventrad to the gut are represented by lines of alternating dots and dashes, thus ..... This has been done to distinguish them from the tracheoles which either run along, or pass into the ventral rectal walls, and are represented by broken lines, thus -----. The tracheoles which run along or pass into the dorsal rectal wall are represented by solid lines.

#### Abbreviations.

<i>anas</i> , anastomosis.	<i>r</i> , rectum.
<i>dlc</i> , transverse tracheæ connecting the dorsal and lateral longitudinal tracheæ.	<i>rcgt</i> , right caudal gill trachea.
<i>lcgt</i> , left caudal gill trachea.	<i>rdrt<sub>1</sub></i> , anterior or chief right dorsal rectal trachea.
<i>ldrt<sub>1</sub></i> , anterior or chief left dorsal rectal trachea.	<i>rdt</i> , right dorsal trachea.
<i>ldrt<sub>11</sub></i> , posterior or secondary left dorsal rectal trachea.	<i>rlrt<sub>1</sub></i> , anterior or chief right lateral rectal trachea.
<i>ldt</i> , left dorsal longitudinal trachea.	<i>rlrt<sub>11</sub></i> , posterior or secondary right lateral rectal trachea.
<i>llt</i> , left lateral longitudinal trachea.	<i>rlt</i> , right lateral trachea.
<i>llrt<sub>1</sub></i> , anterior or chief left lateral rectal trachea.	<i>rmcgt</i> , right median caudal gill trachea.
<i>llrt<sub>11</sub></i> , posterior or secondary left lateral rectal trachea.	<i>rvs</i> , right visceral trachea.
<i>lmcgt</i> , left median caudal gill trachea.	<i>sp7</i> , unopened spiracle of the 7th abdominal segment.
<i>lvs</i> , left visceral trachea.	<i>sp8</i> , unopened spiracle of the 8th abdominal segment.





junction of the Malpighian tubes with the gut where it breaks up into small tracheoles ramifying among these tubes and about the circular muscular coat of the gut.

The distribution of the right visceral trachea (*rvs*) and its branches is similar to that of the left; except that, while it gives off tracheoles to the right ventro-lateral fold (No. 4) of the intestinal epithelium, it gives off none to the dorsal fold.

The left lateral rectal trachea (*llrt*<sub>1</sub>) and the right lateral rectal trachea (*rlrt*<sub>1</sub>) give off tracheoles respectively, to the left ventro-lateral rectal longitudinal fold (No. 8) and the right ventro-lateral rectal longitudinal fold (No. 4), (Figs. 6 and 4).

It will be seen that, in the main, the abdominal tracheal system of this *Mecistogaster* larva is similar to that described by Calvert for *Thaumatonera* (1915, Plate XVI, and pp. 388, 389) and by Cullen and by Jamieson for *Argia* (1918, pp. 77, 79, figs. 1, 2; pp. 82, 84, figs. 1, 2). For convenience in comparison I have used the same nomenclature and abbreviations as employed by those authors.

#### RECTAL RESPIRATION.

A glance at Figure 6, shows that the tracheole supply of the hind-gut is not rich, and is limited to those portions of the latter which have been described as having longitudinal folds of thick columnar epithelium. All of the tracheoles have been traced, as far as possible, to their terminations. Owing to the fact that cell boundaries in the intestinal epithelium are indistinct, it could not be absolutely determined if any tracheoles terminate inside cells. Usually the twigs appear to end just within the basement membrane of the columnar epithelium of the rectal folds; so seem to end, for instance, the twigs seen between sections 300 and 320. Sometimes, like the terminations of *llrt*<sub>1</sub> (sections 320 to 340) and the caudal branch of *rdrt*<sub>1</sub> (sections 260-280), the twigs seem to end outside the basement membrane. Sometimes, as in the twigs running cephalad from *llrt*<sub>1</sub> and *rlrt*<sub>1</sub> in sections 178 to 200, the terminations may possibly be within the cells. Others may pass between the cells. But one fact is clearly evident and seems to be significant: all the tracheal twigs end on the basement membrane side of the thick columnar epithelium. The tracheoles are at all points separated from the lumen of the gut by the thickness (41 to 83 micra) of the columnar epithelium.

Furthermore, the columnar epithelium is the only part of the internal rectal wall which has a tracheal supply. No twigs to the

pigmented areas between these folds could be found. The extensive folds of spongy or reticulate tissue, covered on the inside by a thinner epithelium, and extending from about the middle of segment IX to the end of segment X, also seem destitute of tracheoles.

In view of the above facts it seems improbable that any diffusion takes place between gases in the rectal tracheoles and those in the water in the rectum. This conclusion is strengthened if the position of the rectal tracheal twigs in *Mecistogaster* is contrasted with the position of the tracheal gill capillaries in Anisopterous larvæ, where diffusion of oxygen is known to take place. The gill capillaries in Anisopterous larvæ (Tillyard, 1915, p. 425, Figs. 3 and 5; also 1916) lie "in a thin layer of very flattened cells," the gill epithelium. They lie, too, "fairly close up" to the chitinous cuticle of the gill. They are very numerous, excessively fine, and each forms a complete loop. In *Mecistogaster* the tracheal twigs are separated from the chitinous lining of the gut lumen by a thick epithelium, they are not excessively fine, do not form loops, and are not numerous. They are absent, except for one small area (sections 60 to 80), in segment VII, in which, together with segment VIII, lies the gill basket of Anisopterous larvæ (Tillyard, 1916, p. 139).

Nevertheless, there must be other means of respiration in Zygopterid larvæ than that through the caudal gills. Calvert (1911 b, p. 455) found in *Mecistogaster modestus*, "as in most, perhaps all, Zygopterous larvæ, the caudal gills may be lost without interfering with growth, development and transformation." Mr. Bodine (1918), has recently succeeded in keeping Zygopterid larvæ, from which the gills had been removed, alive for three and four days when confined at the bottom of a Mason jar filled with stagnant water.

If we exclude respiration through the integument, the only alternative seems to be some sort of rectal respiration. In support of the latter we have Calvert's observations on living larvæ of *Calopteryx maculata*, *Hetaerina americana*, and *Argia moesta putrida* (Calvert, 1915, pp. 437-442). He found regular rhythmic pulsations of the rectum, with inhalations and expirations of water, in these forms may be carried on for long periods. Tillyard (1916, pp. 410-413) found regular rectal pulsations in newly hatched larvæ of *Austrolestes leda* up until they were half an hour or more old, when the movements became intermittent.

If rectal respiration occurs in the larvæ of *Mecistogaster modestus* the only areas which seem morphologically suitable for an exchange

of gases are the longitudinal folds of spongy or reticulate tissue. In this connection it may, or may not, be worth noting that Calvert (1911 b, p. 453 and Plate XVII), in dissecting *Mecistogaster* larva No. 1, found, "when the viscus was first opened the three non-cellular bands [folds of spongy tissue just referred to] had the shiny, silvery appearance which suggests enclosed air." But, since these areas either lack entirely or have a very scanty tracheal supply, the oxygen would have to be taken up and carried by the blood.<sup>2</sup>

We are not able to correlate any peculiarity of the tracheation of the larva of *Mecistogaster modestus* with its habit of living in the water between the leaf-bases of epiphytic bromeliads (Calvert, 1911 a).

In the study of these slides and in the preparation of the manuscript I am indebted to Dr. Calvert for suggestions, directions, and corrections.

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<sup>2</sup> Tillyard suggests (1917, p. 116) that in Zygoterid larvæ the rectal pads (glands or folds) act as blood-gills, liberating carbonic acid gas from the blood into the rectal water supply, by diffusion, and receiving air in exchange. This hardly seems likely. The blood is separated from the water in the rectum by the basement membrane, the thick (41 to 83 micra) columnar epithelium and the chitinous intima.

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#### IV. EXPERIMENTAL RESULTS IN ISCHNURA AND ENALLAGMA.

BY JOSEPH HALL BODINE.

(The following paper was written out by Mr. Bodine in nearly the form here presented. Owing to his having entered the war service of the United States, it is unlikely that he will be able to continue these researches for many months. He has placed his manuscript in my hands with the wish that I do with it as I think best. I have made some slight verbal changes, but otherwise the paper represents the author's own observations and conclusions.—*Philip P. Calvert.*)

The problem of the physiology of respiration among insects is by no means a settled one and presents a great many obstacles to its solution, especially in certain aquatic stages.

The types, theories, etc., of respiration found in insects have been much discussed and can be easily learned from any of the more recent text-books of entomology and comparative physiology and hence need not be taken up here. I shall deal entirely with the phenomena among the dragonflies, restricting the problem to the suborder Zygoptera.

The morphological studies upon the structure of the rectum and caudal gills of the larvæ of Zygoptera bring forward several questions, as to the exact function of these parts.

The organs generally supposed to be concerned in the respiration of these larvæ are the caudal tracheal gills, the so-called rectal gills or folds, the body surface and the spiracles. The structure of the rectal gills or folds, especially as regards the distribution of tracheæ to the same is discussed in the papers of Calvert, Jamieson, Cullen and Carroll, and need only be referred to here. (The structure of the caudal gills has been described by Tillyard in 1917, in a paper published after Mr. Bodine's work ceased.—P. P. C.)

Various theories of respiration for these larvæ have been proposed, some of which are quite conflicting and the remainder are based rather upon philosophical, than physiological, ideas.

Briefly stated and outlined these theories are as follows: Réaumur (1742) and Roesel von Rosenhof (1749) regarded the caudal gills

as having a fin-like or rudder-like function, mentioning no respiratory function whatever. Dufour (1852) and Roster (1886) ascribed to them the functions of respiration and locomotion. Sharp (1895), remarking that the nymphs lived after removal of the caudal gills, thought their respiratory function must be of an accessory nature. Heymons (1904) held that the entire body surface serves for respiration in addition to the gill-appendages.

A respiratory function was first attributed to the rectum in this group by Roesel von Rosenhof (1749). Dufour (1852) described the gills in the rectum and from this time on a respiratory function has often been assigned to them. Calvert (1915) has given a detailed account of the manner in which water is taken into and expelled from the rectum, and from these observations, we must undoubtedly ascribe to the rectum a relation to the respiratory functions of the nymph. Tillyard (1916) asserts that in early larval life, immediately after hatching, for a period of half an hour or so, the rectum contracts vigorously and to these contractions assigns a respiratory function, especially since he thinks the caudal gills of the very young larvæ are incapable of carrying on respiration. This conclusion is undoubtedly true, but in later periods of the larval life, he attributes to these intermittent contractions only a possible respiratory function, governed "by the efficacy of the total of other respiratory activities. Respiration through caudal gills, through lateral abdominal gills when they occur and through the integument in such cases as it may occur, all differ from rectal respiration in being practically continuous, carried on without special efforts on the part of the larva. Consequently, if the caudal gills have a poor tracheal supply, or a very tough integument, or if the general integument of the larva be unsuitable for respiration by diffusion, the call on the larva for rectal pulsations must be heavier."

If these statements be true, larvæ which are old and hence have thicker chitin over body and gills ought to show rectal pulsations to a greater degree than the normal larvæ. Such a condition, however, has not been found to be the case in the larvæ examined, but such larvæ have contractions quite like those younger and with softer chitin. Tillyard continues: "If the caudal gills are accidentally lost, we should expect that the rate of rectal respiration would be increased." When the gills are removed one at a time, or all together, no change in rate of rectal respiration has ever been noticed, hence we can be quite sure of the non-respiratory function of these caudal gills.

Tillyard's earlier views (1915) as to the respiration of the Zygoterous larvæ are stated as follows: "Firstly, I shall deal only with the suborder Anisoptera, *i. e.* those dragonflies whose larvæ breathe by means of rectal gills, and shall not consider the somewhat different problem presented by the *Zygoptera, whose larvæ breathe by means of caudal gills.*" (The italics are ours.)

Calvert (1915) says, "From the various data which have been brought together here, it seems reasonable to suppose, at least until much more exact experiments show the limitations of each mode of respiration for different stages and for different species of Zygoterous larvæ, that the general body surface, the caudal processes, the rectal epithelium, certain spiracles and in a few species lateral external abdominal tracheal gills, all contribute to satisfying the needs of the organism for oxygen."

Summing up this historical treatment of the possible functions of these parts in respiration we find that three methods for the taking in of oxygen by the larva are described, (1) by the caudal tracheal gills—(2) by the rectal gills—(3) by the surface of the body (including spiracles).

Each of these will be discussed in turn and reasons for considering them heretofore as entering into the phenomena of respiration, will be given.

I. *The caudal tracheal "gills."* These, three in number, situated on the caudal end of the abdomen, have a structure which seems admirably adapted for a respiratory function. Normally, they are present on the larva throughout its life, but are, at the time of transformation, left behind on the exuvia in their normal position and relation. Their presence, however, does not seem to be necessary, because larvæ with one, two or all of them missing, live apparently normally and transform into the adult in the usual manner. Hence, if they do act as respiratory organs, it must be only in a secondary manner. They do, however, aid the larva in swimming, acting as fins or as rudders. When at rest the larvæ have the tendency to move the abdomen in a wave-like fashion from side to side, the "gills" in this case possibly acting only as mechanical devices for the stirring up of the water and hence in bringing water in which the content of oxygen is richer near the larva.

If they have (as many hold) a respiratory function, how can the larva continue to live and reach maturity, when they are completely removed? This seems to entirely eliminate them (or at least to cast much doubt on their rôle) in a consideration of

respiration. Other organs must take up a respiratory function after the removal of the caudal "gills" from the body, but this idea is scarcely conceivable since it would be almost impossible for the animal to adjust any such structures in so short a time. Since these other organs seem especially adapted to a respiratory function, their existence makes the possible respiratory function of the caudal gills seem quite improbable.

II. *The rectal folds or gills.* The structure of these, associated with the observed intake and outgo of water into the rectum through the anus, seems to warrant their inclusion in the consideration of possible respiratory functions. The only other function which could be assigned to the intake and outgo of water into and from the rectum is that of a locomotor one. This, however, is rather improbable for several reasons. These larvæ, when moving in the water, do so by a worm-like wriggling of the body and do not "shoot" through the water as do the Anisopterous larvæ where the rectum does have a locomotor function. The water when expelled from and taken into the rectum does not create currents strong enough to propel the larva through the water. They are produced when the larva is at rest and in this case do not move it.

The function of respiration, then, can be assigned to the rectum, until another possible means for this function can be found. The possible respiratory function of the skin will have to be considered before one can draw a final conclusion, however.

III. *The skin.* The skin, or hypodermis and chitin, of the larvæ, varies in thickness and hardness according to the length of time from the preceding moulting period. Just after exuviation the chitin is soft and quite transparent. Soon it becomes hard, thickens and becomes quite dark in color. Ramifying throughout the surface of the larva are innumerable, fine, thread-like tracheæ which join larger branches and finally these latter unite with the main tracheal trunks. The thread-like tracheæ being found over the entire surface of the larva's body, afford a very large area exposed directly to the water by which the larva is surrounded. Thus the structure of the skin seems to warrant its consideration as a means of respiration.

IV. *Spiracles.* Spiracles on the thorax and abdomen are supposed to function when the larvæ crawl up out of the water into the air. This idea, perhaps true, need not be considered here because we shall only deal with respiration as carried on when the larvæ are actually submerged. However, when the larvæ come to the

surface, and especially at the time of transformation, respiration must be carried on by this method, since the larvæ have then come to the end of their aquatic existence and no longer need those means of respiration previously employed but rather are ready to begin an aerial existence, hence respiration by means of spiracles.

#### EXPERIMENTS.

Various experiments made during 1916 and 1917, seem to throw some light upon the possible respiratory mechanisms of Zygopterous larvæ. The larvæ used were of species of *Ischnura* and of *Enallagma*, obtained from small ponds at Primos, Pennsylvania. Many individuals were employed, the experiments were repeated several times and the data for each set of experiments represent average results.

The normal larva (with three caudal "gills") when observed under a binocular microscope and in a Syracuse watch glass, show rhythmic pulsations in the rectum, in the manner described by Calvert (1915) for the larva of *Hetaerina americana*, i. e., each pulsation consisted of three to four successive contractions of the rectum, followed by a pause. No uniformity, however, in the number of contractions per minute seemed to exist; this was possibly due to age, size and environment of the larvæ under examination. Particles of carmine and of lampblack were also used and these were seen to go in and out of the rectum.

The current of water taken in and expelled was not so forcible that a possible locomotor function could be ascribed to it. The currents were not strong but rather weak and of only sufficient strength to be taken into and expelled from the rectum so that a change of water could be brought about.

The three caudal gills were then removed as follows: the larva was placed under a binocular microscope as above and a fine needle, bent at a right angle was used to remove the gills. The needle was placed on the particular gill to be taken off and the larva pulling away under this stimulus, broke off the gill at its attachment to the posterior end of the abdomen. By this method the three gills were successively removed. The results obtained were the same whether one, two or three gills were removed at the same time or at intervals. The rate of rectal contractions was not increased or decreased at the time of operation and several hours afterward the contractions had not changed their regular normal rhythm.

These larvæ, after the removal of the gills, behaved normally and lived in a regular way, and moulted as did larvæ with gills.



To determine whether the larvæ breathed through the skin several experiments were conducted. Glass battery jars were filled with pond water and into them were put both larvæ with gills and also those from which gills had been removed. A fine gauze was then stretched across the jars about two inches below the water's surface, so that the larvæ could not come up to the air. Larvæ kept under these conditions, as well as those kept in jars from which the gauze was absent, lived for periods of four to six days—depending of course, upon the amounts of available food substances present in the water. The food question, however, can be eliminated, because both the larvæ in the controls, as well as those under experiment, were kept in water obtained from the same pond and were under similar laboratory conditions.

The same experiment, performed in a slightly different way, gave like results. Larvæ, both with and without gills, were put in vials, the ends of which were covered with gauze, and the vials were then dropped into battery jars containing pond water. Larvæ put into distilled water in the same manner as above, lived only one to two days—in all probability due to food and osmotic conditions of their environment.

When the water was previously boiled the length of life of the larvæ was greatly reduced—to one and one-half days when under the above conditions. This is doubtless due to lack of food and oxygen in the water used.

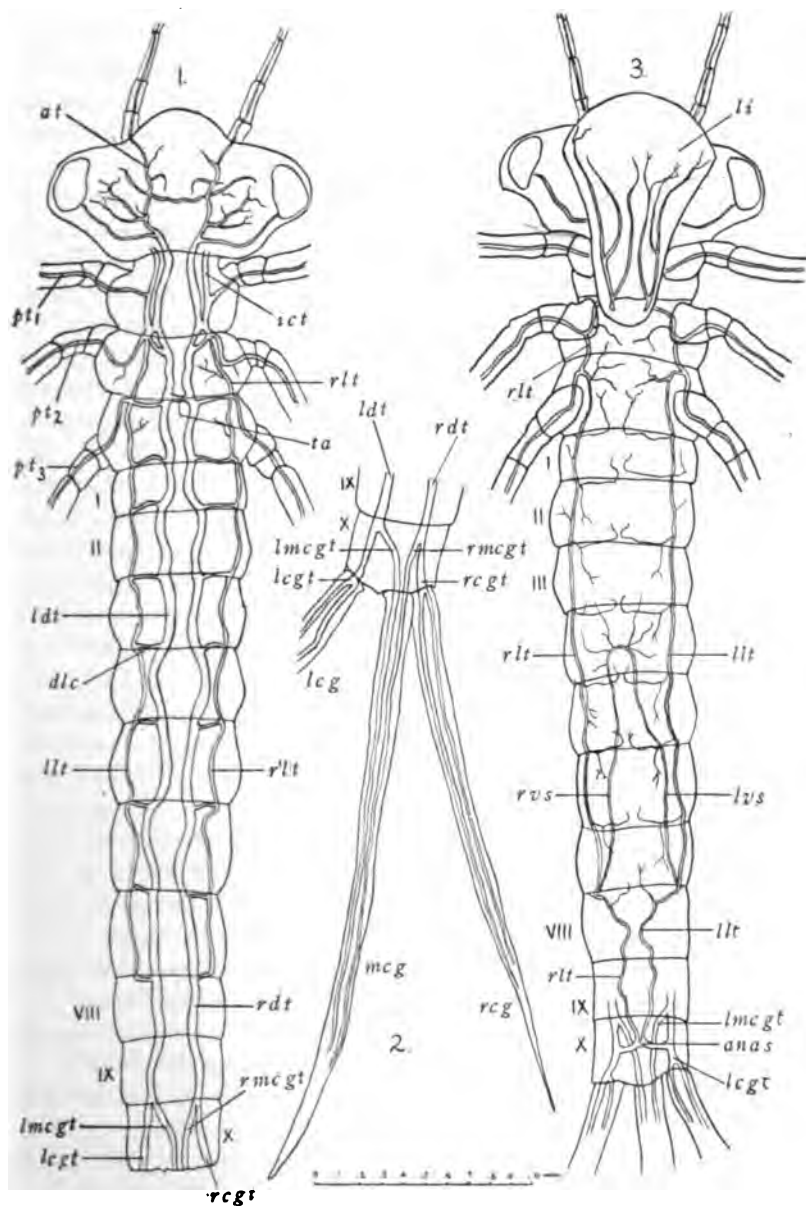
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Tracheal System of larva of *Enallagma* sp., from Primos, Delaware County, Pennsylvania. Larva No. 101. Drawings made by J. H. Bodine, November 12, 1915. Fig. 1, dorsal view. Fig. 2, dorsal view of hind end of abdomen with caudal gills. Fig. 3, ventral view. From a transparent specimen. (These are, perhaps, the first complete views, dorsal and ventral, of the tracheal system of an Agrionine larva to be published. A highly magnified drawing of the distal part of a caudal gill in lateral view was published by C. G. Carus as long ago as 1827.—P. P. C.)

#### Abbreviations.

<i>anas</i> , anastomosis of tracheæ in abdominal segment X.	<i>lmcgt</i> , left median caudal gill trachea.
<i>at</i> , antennal trachea.	<i>lvs</i> , left visceral trachea.
<i>dlc</i> , transverse trachea connecting dorsal and lateral longitudinal tracheæ.	<i>mccg</i> , median caudal gill.
<i>ict</i> , inferior cephalic trachea (to maxilla and labium).	<i>pt1, pt2, pt3</i> , tracheæ of 1st, 2nd and 3rd legs, respectively.
<i>lccg</i> , left caudal gill.	<i>rcg</i> , right caudal gill.
<i>lcgt</i> , left caudal gill trachea.	<i>rcgt</i> , right caudal gill trachea.
<i>ldt</i> , left dorsal trachea.	<i>rdt</i> , right dorsal trachea.
<i>li</i> , labium.	<i>rlt</i> , right lateral trachea.
<i>llt</i> , left lateral trachea.	<i>rmcgt</i> , right median caudal gill trachea.
	<i>rvs</i> , right visceral trachea.
	<i>ta</i> , thoracic anastomosis.

The Roman numerals denote the numbers of the abdominal segments.



From these experiments we see, that respiration must be carried on by one of two methods—(1) by the rectum or (2) through the integument. The probability of the passage of the air of the water, through the chitin of the body is quite doubtful. The larvæ used were for the most part of rather hard, thick chitin and the passage of the air through this would be very slow and in all likelihood too small in amount to serve the entire respiratory needs of the larvæ. The possibility of the larvæ getting near or on the surface of the water and taking in air through the spiracles present on the thorax or directly through the skin is excluded, since the larvæ could not get to the surface. The only method left, by which the air could have been taken in, was by means of the rectum. The manner in which the air is taken out of the water by the larval rectum is one of dispute and need not be taken up here. Tillyard (1915) has admirably discussed this question and reference to his work will show the present views.

In experiments made with other objects in view, viz., the action of certain gases or fumes of different chemicals, *e. g.*, ether, chloroform, etc., upon the heart's action, very interesting phenomena were observed with respect to their effects upon the contractions of the rectum. The details of these experiments will not be given now, but their effects on the respiratory phenomena in which we are interested will be considered.

Before the various gases affect the action of the heart, violent contractions of the rectum always precede and very shortly afterward the effects upon the heart's action can be observed. In an animal which has been under the influence of the gas and is recovering, similar contractions of the rectum can be observed before the heart again beats normally. These observations would seem to show that the gas is first taken into the rectum and distributed from it to the other parts of the body. The contractions, when the animal is recovering, would also seem to indicate that air must be carried to the tissues before normal activities could again be resumed.

If the larvæ breathe through the skin, these contractions of the rectum would be quite superfluous. They cannot be due to the action of the gas used, as when the larva was recovering, it was kept in normal atmosphere, away from the effects of the gas. Hence the rectum must in some way act as a respiratory center for the larvæ.

The distribution of the tracheæ, and the general structure of the rectum of the larvæ employed in these experiments correspond

fairly closely to that of the other species studied in the papers by Cullen, Jamieson, Carroll and Calvert.

Whether the air which enters the rectum is carried from it by the tracheæ or whether it diffuses through into the spongy tissue in contact with the basement membrane of the rectum and is then carried by the blood to the different parts of the body, is at present, rather difficult to say on purely physiological grounds and will require more intensive study.

From a morphological study of the species of larvæ used in my experiments, carried out in a way similar to those of Calvert, Jamieson, Cullen and Carroll, I find that the number of tracheæ and of tracheoles, distributed to the rectum is very small—much too small to supply or take up sufficient oxygen for the respiratory needs of the larvæ. Doubtless the greater part of the oxygen diffuses through the spongy bands as suggested by Carroll.

If oxygen from air in the water diffuses through the walls of the rectum and is taken up by the blood and is thus distributed to the various parts of the body, the tracheæ and tracheal trunks must be accessory structures, since otherwise the oxygen would have to be taken up by them from the blood and be distributed by them to the various parts of the body. This is hardly conceivable, since the blood is found to circulate freely to all parts of the body. One fact which would point to such a function of the blood is, that the heart's action when subjected to different gases, is not interfered with until after violent contractions of the rectal wall have taken place, showing that possibly the gas is carried directly to the heart by means of the blood and not by means of the tracheæ. On the other hand, from morphological studies already cited (Calvert, Cullen, Jamieson and Carroll) we see that the tracheal supply to the rectum and especially the manner of ending of the tracheoles, would seem to indicate the possible diffusion of the oxygen through other places than those where these tracheoles end (Carroll). If such a condition is found, the problem becomes one quite different than heretofore supposed—the tracheoles and tracheæ then must play only a secondary rôle in the distribution of oxygen to the body if at all; the blood must be the important means of transportation of oxygen either to the tracheæ, or directly to the various parts of the body.

Tillyard (1916) says regarding the mode of diffusion of air in *Zygopterous* larvæ: "The diffusion of  $\text{CO}_2$  outwards into the rectal water supply, and the diffusion of air inwards, is undoubtedly effected

through the rectal epithelium *without any specialisation of the tracheal supply of that region*, and the exchange must be regarded as being primarily one between the blood of the larva and the water in the rectum, quite irrespective of the tracheal system, which is bound to benefit sooner or later by the change." His idea based almost entirely upon speculative grounds, perhaps can be better justified after the detailed morphological work on the tracheal supply has been done. His attempt, however, to correlate the thickened folds of rectal epithelium of Zygopterous larvæ with the basal pads of Anisopterous larvæ, especially as regards the elimination of carbon dioxide, are, perhaps, not so well founded. The detailed morphological work has shown that these folds are the definite cellular parts of the rectum and have a tracheal supply. The great quantities of spongy tissue present between the folds suggests the supposed function attributed by Tillyard to the folds themselves, viz., the elimination of carbon dioxide.

#### CONCLUSIONS.

1. Zygopterous larvæ breathe by means of the rectum from the time of hatching until transformation.
2. Caudal "gills" serve only in a mechanical way, as rudders in the locomotion of the larvæ.
3. Respiration through the skin of the larva is doubtful, but if it takes place, is only in a very slight degree, not supplying enough oxygen for the respiratory needs of the larva.
4. Regular rhythmic contractions of the rectum take place throughout the aquatic life of larvæ.
5. Rhythm of rectal contractions is not interfered with by removal of the caudal "gills."

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## NEW GENERIC NAMES FOR UPPER CRETACEOUS GASTROPODA.

BY BRUCE WADE.

In a recent paper entitled *New and Little Known Gastropoda from the Upper Cretaceous of Tennessee*, published in the Proceedings of The Academy of Natural Sciences of Philadelphia for September, 1917, pp. 280-304, there were several errors which crept in because of the necessity of preparing the paper for publication after the writer left Baltimore and had entered the U. S. Artillery service.

It is the purpose of this brief note to rectify these mistakes and omissions. The family name *Fusidæ* should have been inserted over the genus *Falsifusus* on page 284, and similarly the family name *Busyconidæ* should have been inserted over the genus *Boltenella* on page 285.

The generic term *Hyllus* (page 281) has been found to be much preoccupied and the new name *Parafusus* is here proposed to take its place, the type thus becoming *Parafusus callilateras* and the second species, *Parafusus coloratus*. Similarly the term *Scobina* (page 286) is preoccupied and for the latter the name *Haplovoluta* is proposed, the type species becoming *Haplovoluta bicarinata*. The new Buccinoid genus *Seminola* is not regarded as being preoccupied by the Coleopteroid genus *Seminolus* of Mulsant (1869) although the two are dangerously alike and a different term would have been proposed in the first instance if the writer had been aware of Mulsant's genus.

APRIL 9.

MEETING

IN MEMORY OF SAMUEL GIBSON DIXON, M.D., LL.D., Sc.D.

EDWIN GRANT CONKLIN, Ph.D., Sc.D., Vice-President, in the Chair.

The Presiding Officer, in opening the meeting, remarked :

We have met to commemorate the life and public services of a distinguished man, SAMUEL GIBSON DIXON, who has passed forever from our view, but whose influence and labors will remain long after we also shall have joined the "great majority." Others who knew him most intimately in the various phases of his many-sided life and work will speak at length of his services to science, to the State and to this Academy, but as one who was associated with him for many years in the Council of the society, I cannot refrain from calling attention to the many evidences of his ability and foresight which are all around us. This very hall in which we are meeting we owe to his activities. The Academy had a great history when Dr. Dixon became its President. It had great collections, an unexcelled library, a distinguished scientific staff, and a national and international reputation in science, but it was inadequately housed and endowed. With great energy and ability Dr. Dixon set himself to the task of providing a suitable home and a larger endowment for the institution. Contrast the old building with the present group of buildings, the old Library Hall with this cheerful and inspiring one, the old accommodations for the scientific staff with their present work-rooms and laboratories. We might truly write on his memorial tablet, "He found the Academy crumbling serpentine and left it enduring steel and stone."

Dr. Conklin then presented the Hon. John Cadwalader, Vice-President of the Academy; Witmer Stone, Sc.D., and B. Franklin Royer, M.D., who made the following addresses:—



**LEGAL ATTAINMENTS OF DOCTOR DIXON.****BY JOHN CADWALADER, LL.D.**

DR. SAMUEL GIBSON DIXON was a man of such varied abilities and had exerted them to such an unusual degree in benefiting his fellow-men that all phases of his life present points of interest and justify the consideration of his career in its different periods.

In his very early years he exhibited such activity of mind and such earnestness of purpose that his father said of him that "there seemed to be no limitation to his development." When a man has been a successful lawyer, a doctor of medicine, filling an important chair in a leading medical school with high scientific attainments; for twenty-two years the President of the Academy of Natural Sciences of Philadelphia, and in 1905 assuming as Commissioner the entire control of and practically creating the Health Department of the Commonwealth of Pennsylvania under the continuous reappointments by four Governors, it may well be said of him that his life has been remarkable and well spent.

The Chairman has spoken and others will speak of his work for the Academy and for sanitary science. I have been asked to refer to those years during which he devoted himself to the law.

The law has been well called "A Jealous Mistress," requiring untiring attention. Dr. Dixon only entered on the threshold of a lawyer's life and, of course, had not reached the stage of distinction which only comes to men after years of experience. I am sure, however, that his study and limited time in practicing the profession had a distinct influence in his career.

The material growth of industries and commercial interests of all kinds has brought into such prominence the "Captains of Industry" and "Napoleons of Finance" that the great profession of the law is not appreciated as it was half a century ago and for centuries before that time. Lord Campbell, in dedicating his "Lives of the Chief Justices of England" to his son Dudley, wrote: "As you have chosen the noble though arduous profession of the law I dedicate these lives to you in the hope that they may stimulate in your bosom a laudable ambition to excel, and that they may teach you industry, energy, perseverance and self-denial," and "ever bear in mind that truly enviable reputation is only to be acquired by

independence of character, by political consistency and by spotless purity both in public and private life."

Dr. Dixon's early leaning was the study of chemistry and from that to medicine generally. His health, however, as he reached manhood was not good and he went to Europe, visiting Vienna in 1873 during the World's Exhibition held in that year. On his return, when about twenty-five years old, he entered the office of his brother, Edwin S. Dixon, and studied law with him and at the Law School of the University of Pennsylvania, being admitted to the Bar on June 30th, 1877.

It is of interest to recall the fact that Dr. Dixon's immediate predecessor as President of the Academy, Gen. Isaac J. Wistar, was also a man of varied pursuits and until the Civil War practiced law.

In 1886 Dr. Dixon received his degree of Doctor of Medicine from the University of Pennsylvania, so that his years at the Bar were not more than six. The importance of those years in rendering more useful his distinguished career in his later activities is not probably recognized by many.

The training in a lawyer's office before the system of acquiring knowledge of the law entirely in a school, as at present, was of great value. A student under a careful preceptor was guided in his reading and studies. He had the advantage of being able to apply his knowledge to the daily business of the office. Typewriters and stenographers and even office boys had not then been introduced, and all letters and papers were copied, notices were served and messages carried by the students. The student then not only acquired practical knowledge of the duties of a lawyer, but he became known to the members of the Bar and clients in a way that enabled him to gain their confidence if it was deserved.

In an office of general practice every kind of business and occupation and the method of being conducted have to be investigated. A lawyer should be an expert accountant and bookkeeper, with an insight into all commercial and manufacturing methods. Until title companies superseded the work of the *conveyancer*, I mean in the correct sense and not that of a *scrivener*, which is usually meant, the lawyer had to possess the closest familiarity with all the incidents connected with real estate and mortgages and the rights of inheritance. In these and many other fields the lawyer of fifty years ago was very truly *Une homme d'affairs*.

The profession of the law is more important in this country than

in any other, as we live under the written Constitutions of the State and the United States. It is extremely difficult for any man not trained in the law to comprehend his duties as a citizen. We all realize if a Legislature or Congress passes an Act that affects our interests we must consult a lawyer to ascertain how we are to meet its requirements. The recent income tax laws are in point. But very few think of the fundamental constitutional regulations that override and control all legislation. It is largely for these reasons that lawyers have been called upon to fill every class of executive duty. A few years ago a greater number of railroads were presided over by lawyers than by any other class of men, and the great trust companies and even banks seek lawyers as their presiding officers.

I have referred to these facts to apply them to the case of our late President. Short as his career was at the Bar, his keen clear intellect had grasped the main principles of the law and he had entered upon a successful professional life. Admitted in 1877, as early as January Term, 1878, his name appears in the Supreme Court Reports. The case referred to was one involving a nice point of law, and the opposing counsel was a leader of the Bar and one of the most distinguished men in the profession, the Hon. Peter McCall. The case was decided in favor of Dr. Dixon's clients, an important fact for a young advocate.

The office of Edwin S. Dixon and Samuel G. Dixon was noted for its accurate and careful attention to every case and matter submitted to it. In connection with cases involving real estate they were especially competent and met on equal terms the Nestors of that branch of the law at that time, Eli K. Price, Edward Olmstead, William Henry Rawle and Henry Wharton. These were the men at that date who practically controlled all transactions involving land titles. The details of a lawyer's practice are not of general interest, and I do not recall any incident in Dr. Dixon's years at the Bar requiring special mention. What he gained in those eight years of study and practice he never forgot, and those who have been associated with him on the Council of the Academy can all testify as to his clear insight and sound judgment on questions affecting its material interests as distinguished from the scientific work which demanded his greater attention.

Dr. Dixon fully appreciated all that Lord Campbell said of the legal profession and followed his precepts while a lawyer and in all of his other relations in life. He knew that to excel "industry, energy, perseverance and self-denial" were essential. The envia-

ble reputation he secured could not have been acquired without "independence of character and by spotless purity in public and private life."

The interesting home owned and lived in for six generations of his mother's family called "Waverly," where he was born, still belongs to them. Adjoining Bartram's Gardens the three hundred acres reached the Schuylkill River, where, from their own wharf, they shipped the farm products and caught the shad in the spring, justly prized from those waters. The city's growth has destroyed these advantages which the earlier generations enjoyed, but it is rare that any home in this country remains in the possession of the sixth generation of any family.

Interesting as was his early home, his late residence, near the romantic Mill Creek and overlooking the beautiful hills beyond Ardmore with the rare trees and shrubbery and attractive farm land, was one in which he might have passed his latter days in the truest enjoyment. He gave himself no rest, however, and even the hottest days of summer were spent at Harrisburg in the strenuous performance of his great work of protecting the people of his State from the scourge of disease.

Dr. Dixon was essentially a Philadelphian. He possessed that modesty and freedom from the desire for notoriety or personal distinction which has marked so many of the great men of our city and State. This building, in which is now safely housed the invaluable collections which he and his predecessors have obtained and his work in securing pure air and preserving the waters of the State from pollution, are far greater monuments than any column that could be erected in his memory. A plain tablet recording his name, but not his deeds, as in the case of Franklin, is all that is necessary. Dr. Dixon's monuments at least cannot be overlooked.

My warm friendship for Dr. Dixon renders it a pleasure to contribute in any way to the respect which is owed to his memory, and as a lawyer to record the fact of his having been one of that brotherhood.

**DOCTOR DIXON'S LIFE AND SERVICES TO THE ACADEMY.**

BY WITMER STONE, SC.D.

An institution such as this Academy demands the services of many types of men, and of these three seem to stand out most prominently before us. There is the student of the Natural Sciences, entirely absorbed in his researches, who sheds glory upon the society by his discoveries; the benefactor, through whose generosity these researches are made possible; and the executive, the man of affairs under whose direction the institution is developed.

One of these is equally as important as the other in the welfare of the institution, and lacking any one of the three, successful development is impossible.

It is to the last category that SAMUEL GIBSON DIXON primarily belonged, and it is his untiring energy and devotion in guiding the development of this institution, as executive Curator and President for nearly a quarter of a century, that constitute his great gift to this Academy.

But great as were his services as executive, he was more than this. Directly or indirectly he filled the role of benefactor as well, by securing the funds which made possible the development of the plant of the Academy from the modest building which housed our collections twenty-five years ago to the commodious museum, library and laboratories of to-day. Then, too, his experience in medical research gave him a sympathetic interest in the work of the staff and influenced him in guiding the development of the institution along the lines of scientific research which was its original province and to which its reputation has always been due.

The extent of Dr. Dixon's services to this institution and through it to science in general is appreciated by few outside of our officers and members. It was his later labors in the field of preventive medicine and sanitation, as Commissioner of Health of Pennsylvania, that brought him his great renown, not only throughout the extent of this Commonwealth but far beyond its borders as well, and have made his name a byword in every household of the State, coupled always with the thought of public health. But the details of this work, by far his greatest achievement, as well as his career in the law and its influence on his later activities, are treated of by others,

and I must confine myself to a consideration of his services to this Academy.

Dr. Dixon was born on March 23, 1851, in the old Gibson homestead on the Schuylkill River below Bartram's Garden, where his family had resided since 1721. His father, Isaac Dixon, a respected merchant of Philadelphia, and his mother, Ann Gibson, were members of the Society of Friends, and it was under the influence of the quiet Quaker environment so characteristic of our city that his early life was spent.

As a boy he attended the Friends' School at Fifteenth and Race streets and the Mantua Academy in Philadelphia, then in charge of Prof. Hastings. He later received instruction from private tutors with the idea of preparing for Harvard University. Failure in health, however, necessitated a rest from his studies, which was followed by a trip abroad. Upon his return home all thought of a college course was abandoned and he decided to devote himself to business and the study of law. He took a course in the Mercantile College of Philadelphia and then entered the law offices of his brother, Edwin Saunders Dixon, and attended the Law School of the University of Pennsylvania, being admitted to the Bar in 1877. He continued his law practice for six years, but the necessary confinement and constant strain of office work proved too much for his constitution and once more he was forced to seek rest.

Realizing the necessity for a permanent change of occupation, he now conceived the idea of devoting himself to the scientific side of medicine—a subject which in spite of his choice of the law as a profession had always possessed a deep attraction for him. With this object in view he entered the Medical School of the University of Pennsylvania in the autumn of 1883 and received his degree of M.D. in 1886. He won distinction in his studies and while still an undergraduate was appointed an assistant demonstrator in physiology under the late Harrison Allen.

An attack of typhoid fever during the closing part of his course nearly forced him to abandon his studies, but with characteristic determination he continued his work and passed his examinations. Almost immediately afterward he sailed for Europe, in an effort to regain his health in rest and change of scene. Returning in 1888 he was appointed Professor of Hygiene at the University and soon after became Dean of the Auxiliary Department of Medicine.

In 1889 he again spent several months in Europe, this time in various medical schools in special lines of study connected with

his college work. He took courses in Bacteriology, a science then in its infancy, under Crookshank at King's College, London, and under Klein at the College of State Medicine in the same city, while he studied also under Pettenkofer at Munich, investigating methods of sewage disposal, purification of drinking water and other hygienic subjects.

His duties at the University soon became irksome to him and he longed for more opportunity for original research. He had in 1889 anticipated Koch in the discovery of the branched form of the tubercle bacillus, and had conceived the possibility of the use of an attenuated culture as a preventive of tuberculosis. In experiment he had actually produced immunity in a Guinea-pig, and further investigation of the problem was absorbing all his attention.

As a result he withdrew from the University and determined to establish a private laboratory elsewhere. Through the suggestion of Dr. Henry C. Chapman he came to the Academy of Natural Sciences. Dr. Dixon was elected a member of the Academy February 25, 1890, and in the autumn of that year was granted the use of a room at the eastern end of the old Race street building, which he fitted up as a laboratory. Here for several years, personally and through assistants, he carried on active bacteriological researches. He took part in the meetings of the Academy, became a member of the Microscopical and Biological Section and was elected Professor of Microscopic Technology. He again visited Europe soon after establishing his laboratory at the Academy and made the personal acquaintance of Koch, Virchow and other noted foreign bacteriologists.

Dr. Dixon's intimate association with the Academy naturally led him to take a deep interest in the affairs of the institution and at the close of the year 1891 he was elected a Curator, becoming executive Curator in 1893 and President on December 31, 1895, retaining both offices until the time of his death.

With the assumption of the duties of executive Curator his personal researches in Bacteriology at the Academy, for the time being, came to an end, and his whole time and energy were devoted to the Academy's affairs and to the business management of a large estate of which he was executor.

At the time that his Curatorship began there had been little change in the arrangement of the museum since the Academy had first moved to its present site in 1876. There was but one salaried man in charge of the collections, and while several departments

were in the care of the members of the sections or of individual volunteers, the preservation of most of the historic material belonging to the institution was a serious problem. Dr. Dixon, assuming the position of executive Curator without salary, took over all the responsibilities of the museum management, instituting many reforms and introducing more businesslike methods. Needless to say almost his entire time was spent at the Academy.

Shortly after his election to the presidency the munificent bequest of the late Robert H. Lamborn became available, and he was by virtue of his two offices able not only to direct the general appropriation of this fund, but also to carry out in detail the further development of the museum, which had long been hampered by lack of means. Gradually additions were made to the museum staff until all of the perishable collections were under the care of salaried specialists. By constantly conferring with the members of the staff he ascertained the needs of the several departments and these, under his direction, were provided for as far as possible. Modern cases both for storage and exhibition purposes were installed and the way opened for the accumulation and systematic arrangement of the extensive study collections which have been brought together in recent years, and which have made the Academy more than ever a Mecca for systematists from all parts of the country.

Later Dr. Dixon, largely through his personal efforts, secured several appropriations from the State with which the museum building was enlarged, improved and rendered fireproof—while a new library and a commodious lecture hall were erected, providing for two other important branches of the Academy's activities. The details of all this constructive work—plans, contracts and specifications—he insisted upon attending to in person, as well as carefully superintending the building operations as they progressed. The provision of a fireproof stack for the safeguarding of the priceless library of the Academy was a matter of the greatest satisfaction to Dr. Dixon, as it has been to all who are acquainted with its riches.

In the extension of public education at the Academy, Dr. Dixon took an earnest interest and through his influence the Ludwick Institute, of which he was a director and later Vice-President, was led to establish a course of free public lectures at the Academy under the direction of the Lecture Committee, primarily for the benefit of school children and teachers, in which popular courses in various branches of natural history are given every year.

A mere summary of developments and improvements in such an



institution as this mean but little unless one is familiar with early conditions and those which we face to-day. Many can no doubt remember the cramped antiquated museum building of twenty-five years ago—the scarcity or absolute lack of study material and a single Curator in charge, who from force of circumstances could be little more than a Curator. From this you have seen the development of a great modern museum, with an enormous research collection and a competent staff of specialists constantly engaged in its exploitation and in the preparation of valuable scientific contributions for publication in the Academy's *Proceedings*.

Such a development can only be effected through the wise direction and economic management of a competent executive. In carrying it out Dr. Dixon gained nothing but the satisfaction of a good work brought to completion, while it entailed on his part an amount of voluntary sacrifice of time and energy that few men feel like giving. These are facts that do not show on the surface and are easily forgotten, but they should not be lost sight of in estimating the value of such service.

In June, 1905, Dr. Dixon was appointed Commissioner of Health of Pennsylvania, and immediately began the development of the State department which stands to-day as his greatest monument. Through all these years he maintained his office at the Academy, and many of his plans, especially for the enlargement and improvement of the building, were carried to completion during the period when the multifarious duties of his larger office were such that most men would have found them alone impossible. Naturally, of late years with the activities and responsibilities of the Health Department ever increasing, Dr. Dixon was able to devote less and less time to the Academy, but the planning of earlier years had placed the institution on a basis upon which it ran smoothly and needed less and less the detailed attention of the executive. During his long connection with the Academy Dr. Dixon served upon many of its committees, being Chairman of the Building Committee and also of the Committee in charge of the Centenary Celebration in 1912.

In March, 1892, he was appointed to act for the Academy in conjunction with the State Board of Health in making a bacteriological exhibit at the World's Columbian Exposition at Chicago. He little thought at that time that he would in a few years be head of the department that was to supersede the State Board in caring for the health of the Commonwealth.

During the early nineties he made several communications and

presented several papers at the meetings of the Academy, dealing mainly with the development of *Bacillus tuberculosis*, but including also accounts of *Bacillus typhosis* and *Actinomyces* as well as of beri-beri and the bacteriological examination of drinking water. About this time, through his efforts, the Pennsylvania Antituberculosis Society made the Academy its meeting place and Dr. Dixon became its Vice-President, thus emphasizing his interest in what was to become one of his greatest achievements.

In 1898 Dr. Dixon was appointed on the Board of Public Education in Philadelphia and took an active part in improving the hygienic conditions in the city schools. He was Vice-President of the Zoölogical Society of Philadelphia, a Director of the Wistar Institute of Anatomy, trustee of the University of Pennsylvania, Fellow of the College of Physicians, Past President of the Pennsylvania State Medical Society and a member of numerous medical and scientific organizations. In 1909 the University of Pennsylvania conferred upon him the degree of Doctor of Laws, and in 1916 Lafayette College honored him with the degree of Doctor of Science.

In a life so fully occupied with duties of his official and executive position as was Dr. Dixon's there seemed literally no time for recreation. But in the rare moments when he did indulge in holiday trips or in days of rest in the beautiful country place which he had built at Black Rock, near Bryn Mawr, his deep interest in nature asserted itself. He was always quick to notice unusual birds, striking wild flowers or strange insects, and upon his return to the Academy would seek the aid of specialists in determining their identity and learning something of their history, usually adding some original suggestions as a result of his keen powers of observation. Horticulture, too, was a favorite hobby and the Rhododendron thickets and beds of rare plants that he succeeded in establishing at Black Rock Farm were a source of sincere pleasure and gratification to him.

His visits to the famous tuberculosis sanatorium which he had established at Mont Alto were always a great pleasure to him on account of the splendid mountain scenery and the beauty of the more intimate natural surroundings, of which, on his return, he never failed to speak. This love of nature was always in evidence, and from early youth he had delighted in hunting trips with gun and dogs, which led later to moose hunts in Maine and ducking trips to the clubs of the South Atlantic seaboard. But he indulged in such recreation far too little, especially during the later years of his life,

seeming to neglect in his own case the care that he was ever urging upon others to conserve their strength and health.

Even before his appointment as Health Commissioner those who were closely associated with Dr. Dixon were aware of the inroads that constant attention to his business and executive duties were making upon his health, and on several occasions he had suffered a temporary breakdown. His was a nature that must delve into all the details of every matter under consideration, to make sure that there was no possibility of mistake and that nothing had been overlooked. Praiseworthy as is such a practice, probably no constitution can stand it indefinitely, and in the work of the Department of Health it reached the limit of human endurance.

Even during his long illness, which began about the end of July last, Dr. Dixon's indomitable will continued to assert itself, and for a long while he continued to direct the affairs of his department from his sick bed and to consider the more important matters connected with the administration of the Academy. As time went on, however, he became less and less able to make such effort and the final rest from his labors came on February 26, 1918. Dr. Dixon was married in 1881 to Miss Fanny Gilbert, and she and a daughter, Catharine H. Dixon, survive him.

Dr. Dixon had held the office of President of this Academy longer than any other incumbent, with one exception, having just been elected for his twenty-third term, and no other President had seen, during his administration, such a physical expansion and development of the institution. These things speak for themselves and bear testimony of his executive ability and his devotion to the Academy. To the country at large his work as Commissioner of Health is his monument, and he will stand for all time as an example of the highest ideal of faithful service in public office and as an unselfish benefactor of the people in his campaign for public health.

To those of us who knew him here in the halls of the Academy, however, there will always be memories of the personal side of his relations to the institution and to the staff—his kindness and sympathy, his interest in the work of every individual, and back of it all that constant desire, ever present, ever conspicuous, to advance the Academy's interests and to meet its needs as he saw them; a service, like that rendered as Commissioner of Health, which brought greater benefits to others than it did to himself.

**DOCTOR DIXON'S WORK IN SANITARY SCIENCE.**

BY B. FRANKLIN ROYER, M.D.

Acting Commissioner of Health, Commonwealth of Pennsylvania.

The foundation of SAMUEL GIBSON DIXON'S unprecedented accomplishments in sanitary science was laid the day he took up the study of law in the offices of his brother, Edwin Saunders Dixon; and the erection of the superstructure began with his matriculation in the Medical Department of the University of Pennsylvania. It was probably because of his scientific bent of mind and his interest in chemistry and in physiological processes, in good part brought about by a break in health and search for recovery in 1881, that he gave up law and studied medicine. So far as his intimate friends in the medical class of 1886 know, he did not, as a student, give any indication, either that he was especially qualifying for or anticipating a career in preventive medicine. While a student, however, he did show unusual interest in chemistry and in the scientific side of physiology and before the completion of his course he had received an appointment from the University Trustees as Assistant Demonstrator in Physiology, the main chair being so ably filled by the late Harrison Allen. Throughout his life Dr. Dixon repeatedly referred to this pleasant association and to the stimulation for research work given him by his early master in physiology.

The major Medical Faculty of the University of Pennsylvania during the years when Dr. Dixon was a student (1882-1886) included a number of intellectual giants. The Professors in 1885 and 1886 as listed in the annual catalogue of the School of Medicine were as follows:

- ALFRED STILLÉ, M.D., LL.D., Emeritus Professor of Theory and Practice of Medicine.
- HARRISON ALLEN, M.D., Emeritus Professor of Physiology.
- JOSEPH LEIDY, M.D., LL.D., Professor of Anatomy.
- RICHARD A. F. PENROSE, M.D., LL.D., Professor of Obstetrics and Diseases of Women and Children.
- D. HAYES AGNEW, M.D., LL.D., John Rea Barton Professor of Surgery and Professor of Clinical Surgery.
- WILLIAM PEPPER, M.D., LL.D., Professor of Theory and Practice of Medicine and Professor of Clinical Medicine.
- WILLIAM GOODELL, M.D., Professor of Clinical Gynecology.
- JAMES TYSON, M.D., Professor of General Pathology and Morbid Anatomy.
- HORATIO C. WOOD, M.D., LL.D., Professor of Materia Medica, Pharmacy and General Therapeutics.
- THEODORE G. WORMLEY, M.D., LL.D., Professor of Chemistry and Toxicology.
- JOHN ASHHURST, M.D., Professor of Clinical Surgery.
- WILLIAM OSLER, M.D., Professor of Clinical Medicine.

The influence of such a remarkable group of America's greatest medical teachers undoubtedly molded the mind destined to chart so original a course along new public health lines later in life.

Graduating with honor in 1886 at the age of thirty-five years, the doctorate degree was given to a man broken in health, and in the early stage of what proved to be mild enteric fever. By special arrangement his final medical examinations were given prior to his sailing for Europe, the prostrating illness not being definitely diagnosed until Queenstown was reached. Here under the care of Dr. W. L. Townsend, in consultation with the celebrated Sir Lauder Brunton, and later joined by the master in therapeutics, the brilliant Dr. Horatio C. Wood, Dr. Dixon won the battle against what his physicians thought would be a fatal illness. Those of us who have been closely associated with Dr. Dixon's work in sanitary science have always felt that the influences of the kindly and helpful Townsend and the stimulation of the brilliant therapist Wood, together with the association and life friendship of the learned Sir Lauder Brunton, influenced the young medical mind to study the then infant branch of hygiene—a branch of medicine at that time receiving its greatest impetus on the continent of Europe, particularly in Germany.

After a prolonged holiday in Europe and complete restoration to health, Dr. Dixon returned to Philadelphia in 1888 and was made Professor of Hygiene in the Medical and Scientific Departments of the University of Pennsylvania, and later in the same medical school year was appointed Dean of the Auxiliary Department of Medicine. Dr. Dixon, while holding this Chair, established the first laboratory of hygiene in the University of Pennsylvania and one of the first on the American continent.

In 1889, several months' study in Europe, undertaken with a resolution to perfect himself to teach the science of bacteriology, brought him under the tutorship of Cruikshank, the celebrated bacteriologist in King's College, London, and gave opportunity for taking a special course in bacteriology under Professor Klein of the College of State Medicine in London. It was while a student under Klein that Dixon made a notable observation, one by which he will perhaps be best remembered as a scientific investigator.

As he sat on his stool in Klein's laboratory, looking through the microscope and carefully searching a well stained slide preparation made from a culture of tubercle bacilli, he made the observation that certain of these organisms were club shaped and others appar-

ently had little shoots or branches. Dr. Dixon was very fond of telling of the skepticism in the minds of the other students of this laboratory, and perhaps even in the thought of open minded Klein himself, when they were permitted to look at the branched forms in this microscopic field. Some said the organisms were lying across each other, or that the end of one bacillus projected against the side of another; but Klein said, "Dixon, if this branching is true, you have made a great scientific discovery." He repeated his work, he checked his technique, he wrote a splendid little paper and illustrated it with a drawing which he made himself, showing the new form. That little paper and that small illustration prepared by the youth in research work attracted the attention of the scientific world and fixed a reputation in science.

This brilliant observation in all probability led him into further research in tuberculosis, but in order to still better equip himself as a teacher of hygiene, he did not return to his Chair without having studied with the most noted hygienist of that time, Pettenkofer of Munich. It was in 1889, while studying in the Laboratory of Hygiene, Munich, so far as we know, that he undertook his first studies in purifying large water supplies and the purification of sewage.

On his return to Philadelphia, late in 1889, he was made Professor of Sanitary Engineering in the University of Pennsylvania, and in October, 1889, we find him publishing a paper on the Treatment of Sewage in London. An opportunity has not been had to review the notes of his lectures given during this school year, but those who had the privilege of listening to his instruction, and who are in a position to contrast this instruction with the practices established under his supervision in the State Department of Health of the Commonwealth of Pennsylvania, see worked out in practical detail what was then considered imaginative and by some medical men almost impracticable and visionary.

In 1890, Dr. Dixon gave up his association with the University of Pennsylvania to become Professor of Bacteriology and Microscopic Technology in the Academy of Natural Sciences of Philadelphia, going there solely in the capacity of a scientific worker. Here he was stimulated by the great Leidy.

During his last college teaching year—to be exact, the 19th of October, 1889—the second event in the unusual career of this unusual man occurred. This date is an important one in the career of him to whom we pay tribute tonight. In the experimental

research work undertaken by Dr. Dixon he found that by introducing old cultures of tubercle bacilli into lower animals a certain degree of immunity was produced, and the publication in the *Medical News* of Philadelphia on the above date preceded by more than six months a similar announcement and publication of similar work—that of the celebrated Koch of Germany. Koch announced somewhat reluctantly that a substance could be produced that would prevent the growth of the tubercle bacillus in the human system.

Following Koch's announcement, Dr. Dixon, with authority from American scientific and medical institutions, visited Europe, interviewed Koch, Virchow, DuBois-Raymond, and many others. At this time he had the privilege of admission to Koch's own laboratory. Europe and America were seething with public interest in tuberculosis. Koch's work, as discoverer of the tubercle bacillus and his later work backed by governmental agencies controlling Germany's laboratories, resulted in robbing Dr. Dixon for a long time of that credit of being the first to produce immunity which should have been given him. In recent years American students of tuberculosis have given this credit to Dr. Dixon and to America.

During the latter part of 1890, while working in his laboratory in the Academy of Natural Sciences, Dr. Dixon developed a tubercle bacillus extract that produces in the lower animals and in human beings that same stimulation toward cure in certain types of the disease that has been found by Trudeau, and other students of pulmonary lesions, to be brought about by the various forms of tuberculin. Later, this same preparation was found by surgeons to be effective in the treatment of certain glandular and genito-urinary types of tuberculosis and ophthalmologists found it equally helpful in the treatment of ocular types.

Dr. Dixon's indefatigable energy and originality were no doubt responsible for his selection in 1892 as Executive Curator in the Academy of Natural Sciences, and it is perhaps here and as Curator, that he developed genius for ocular teaching. This experience as Curator, together with his training in hygiene, led to his appointment as a member of the Board of Public Education in 1898. During the greater part of the six year period in the Board of Public Education Dr. Dixon was Chairman of the Committee on Hygiene. It was during this time that the active campaign was conducted for furnishing public school children of the city of Philadelphia with pure drinking

water. The city water supply at this time was unfiltered, the domestic household supply usually being purified by boiling. Filters were installed. In 1902 the Committee on Hygiene began volunteer medical inspection of the Public School children in Philadelphia, the first place in Pennsylvania to undertake such work.

It was while working in his capacity on the Committee on Hygiene that the genius of the man of science stimulated the completion of plans and models (practically invented) for scientific construction of outlets from wash-basins, sinks, and bath-tubs. An illustrated bulletin by the Commissioner of Health as late as May, 1914, shows how actively his interest in such devices continued throughout his busy career as a public health administrator.

As early as 1890 in the annual oration on hygiene before the Pennsylvania State Medical Society in convention at Williamsport, Dr. Dixon gave evidence of public health foresight by visualizing the future work of a State Health organization. In this address, which was later in good part repeated before the State Board of Health of Pennsylvania on Friday evening, May 15, 1891, Dr. Dixon practically forecast the work of a great State Department of Health. Its development came fourteen years later. In that address Dr. Dixon was consistent with his work in later life in that he outlined ideal precautions for protection against tuberculosis, and even suggested a Cabinet Minister of Health to be as useful as a Cabinet Minister of Agriculture for essential national organization.

Dr. Dixon's foundations for administrative work in sanitary science were well and deeply laid in the twenty-two year interval between the time he gave up law to study medicine and during the period of his teaching and research work. When the invitation came to him from Governor Pennypacker in June, 1905, to organize the State Department of Health, provided for by the three Acts of the Legislature of that year, he came to the work with foundation training in science and big business such as no other man in America had. Dr. Dixon had nothing whatever to do with the drafting of the legislation or securing its adoption. In his pursuit of knowledge of preventive medicine, so far as is known, he had not done so with any thought of accepting an executive position such as was offered him by the Governor. The laws creating the Department were drafted by Dr. Charles B. Penrose and it was almost wholly due to the skill, patience and devotion of Dr. Penrose to a subject in which he had become intensely interested while serving as a member



of the Board of Health in Philadelphia that the laws were properly drafted and their approval secured.

In the selection of Dr. Dixon to be the first Commissioner of Health in Pennsylvania, Governor Pennypacker in his autobiography may be quoted:

"The session of the Legislature ended on the 13th day of April. A Department of Health had been created, to which had been given very great authority and power which extended to the person of the individual citizen and might even be regarded as an infringement of his personal liberty. The value and permanence of the legislation would depend upon the manner in which the department would be organized. It was at first suggested to me that it should be placed in charge of Dr....., but that thought I instantly dismissed. I then had an interview with Dr. Charles B. Penrose, who had been very much interested in the matter, and he named to me a gentleman connected with one of the schools in the Western part of the State. I had a talk with this gentleman, but was still not satisfied. Then Dr. Penrose told me he thought Dr. Samuel G. Dixon, President of the Academy of Natural Sciences, would be willing to undertake the task. That suggestion suited me exactly. Dixon consented and I made the appointment. Under his direction it has come to be accepted as the most important and efficient organization for this line of work in the United States. There is good ground for hope that many of the inflammatory diseases due to specific poisons, such as typhoid fever, smallpox, diphtheria and tuberculosis, may be in time stamped out of existence."

Dr. Dixon was commissioned by Governor Pennypacker on the 6th day of June, 1905, and from that day until the day of his death devoted the greater part of each hour that he was awake to the organization and administration of the State Department of Health. The organization was successful almost immediately for the reason that every new step taken by the Department was carefully thought out before being projected, and because the public were fully taken into the confidence of the Commissioner prior to his enforcing any new plan of procedure.

Knowing the common interpretation that the wielding of police authority extending to the person of an individual citizen for the purpose of protecting all might be regarded as an infringement of personal liberty, Dr. Dixon from the beginning tried to change this general acceptance of the public and to make Pennsylvanians see that in civilized life many primitive and individual liberties must be given up to insure the benefits to be had by public health protection. From the very beginning of the State Department of Health the central thought in its educational work was "how may we get close to the people, and how may we make them see public health problems from the viewpoint of benefits to be obtained." Dr. Dixon's preachment, "Pennsylvania's citizens want to be kept well and in good health and are willing to submit to inconveniences if we only show them what to do"—these and similar slogans reached re-

sponsive chords. Pennsylvania liked this new way of being taken into the confidence of an executive.

It is not possible to faithfully treat of Dr. Dixon's work in sanitary science without speaking in some detail of the great public health organization built by him during the last twelve and a half years of his life. It will likely stand as the greatest monument to his memory.

The law creating the Department of Health centralized the authority in the hands of a single executive, giving him greater power than was given to any other officer of the Commonwealth, save the Governor, and perhaps greater authority than is granted any similar official in America.

With all of this authority in the hands of a man known to be ruggedly honest and gentle as a woman, the public had no fear of usurpation of the unusual authority placed in his hands, and during all the period that he was Commissioner of Health many of the unusual powers that might be needed in case of great emergency were never even given trial.

The first organization undertaken was that of the Bureau of Vital Statistics. Under Dr. Dixon's supervision this bureau was so well planned that before it had been in operation a full year the Federal Census Office credited Pennsylvania with having a better organized agency for gathering vital statistics than any other State in the Union. This bureau consists of a central office under the supervision of the State Registrar and more than 1,100 Local Registrars—one for each civil unit in the State, each Local Registrar having a deputy.

The second division of the Department's organization taken up by Dr. Dixon was that of Medical Inspection. Before this division had been in operation a year it was found that all previous plans for public health organization in the civil sub-divisions known as second class townships were inoperative, and that in many of the small boroughs similar inaction was seen.

For the first two years the Division of Medical Inspection was largely engaged in handling epidemics too extensive for local health organizations to cope with, and in helping lame health organizations to form working bodies.

In 1907, however, all second class townships were formed into 720 sanitary districts, and it was suggested to the Legislature that the law providing for school boards to act as Boards of Health therein be repealed. The advice was followed and at once the

Department assumed entire executive supervision over public health matters in a population of more than two million souls.

In all of the countryside, as well as in small boroughs, details were worked out for handling quarantine just as it is done in our large cities. It is fair at this time to say that a great deal of the reduction in sickness from communicable diseases in our larger centers of population is due to establishing proper regulations in the unorganized country villages and on farmsteads, such points prior to that time often feeding infection through food supplies or by visits into the larger centers of population.

The third great division of the Department's organization taken up was that of Sanitary Engineering. One of the Acts upon which the Department is based provided for the prevention of pollution of streams, and Department measures had to be perfected for approving, according to the Act, the plans for all water works and sewage treatment plants. Studies had to be made looking toward the requiring of many cities to build sewage purification works so that municipalities down stream might not be continuously poisoned by filth entering from the neighboring city above.

The amount of work required to supervise and intelligently approve the hundreds of plans brought before the Commissioner in this period of time was in itself almost a full task for one well trained sanitarian. For every set of plans that came before the Commissioner of Health completed and safe for approval in all details, two sets of plans required rejection in some particular, and a goodly number during the early days of the Department required rejection in toto.

The Division of Laboratories was organized as soon as the other divisions were well planned, the organization being made with a threefold purpose in view:

*First*, to afford doctors in the Commonwealth remote from instruments of precision opportunity to study their cases in a scientific way and to apply modern methods of treatment.

*Second*, to properly check the operation of water filtration and sewage purification plants and to coördinate the engineering studies with end results.

*Third*, with the purpose of undertaking such research work as might be advisable.

Division of Distribution of Biological Products.—Early in the history of the Department plans were made for averting the needless sacrifice of life to the ravages of diphtheria. The Attorney

General ruled that the appropriation items were so liberal in their wording that the purchasing of diphtheria antitoxin would be permissible. Stations were established in all populous centers in the Commonwealth and antitoxin was placed within the reach of all Pennsylvania doctors for use in treating the poor.

Divisions of Accounting and Purchasing and Supplies.—From the very beginning of the Department's organization up to the present time systematic keeping and auditing of accounts, and purchasing and distribution of supplies were carried out with precision creditable to a large business concern. Two divisions were devoted to this portion of the Department's business and work, thus giving the executives of the other divisions all of their time for essential public health details.

So firmly had the organization worked out in 1905 been established by 1907, that when the Legislature of that year came to fulfill the campaign pledges of both great political organizations to support an anti-tuberculosis campaign, they deliberately voted \$1,000,000 to the Department of Health to start the work. This was done so that the organization incident to the conducting of a chain of dispensaries and the building of tuberculosis sanatoria for the poor might be worked out along the same lines followed in the organization of the new Health Department. To properly undertake this new line of work, two new divisions were organized—one of Tuberculosis Sanatoria and the other of Dispensaries.

This tuberculosis work lay nearest Dr. Dixon's heart and into its organization he put the best that was in him. Twenty-three hundred free beds in three great sanatoria in the Pennsylvania mountains, and one hundred and fifteen dispensaries, each with its quota of physicians and nurses, followed.

The work of these various divisions was extended and broadened from time to time, each division taking on its new load as directed by the Commissioner. Year after year elapsed, Dr. Dixon being appointed by Governor after Governor, and from time to time the Legislature broadened and made heavier the load by providing additional lines of work and liberal funds for its execution.

In 1915 a Bureau of Housing was created. An organization had to be planned to direct work over the entire State with the exception of first class cities, working for the most part through local health organizations in boroughs, second and third class cities. The Bureau was planned to improve living conditions of the poor, and especially to improve sanitary conditions as affecting the lives and health of infants and children and of workers.

Division of Public Service.—A law enacted during the same session of the Legislature provided for the medical inspection of hotel and restaurant employés, and prohibited the use of the common towel and public drinking cup. An additional division had to be organized for handling this work. During the last months of Dr. Dixon's life three additional divisions were planned.

*First*, a Division for the control of the sale of narcotics, created by a special Act of 1917.

*Second*, a Division of Child Hygiene, planned and organized to meet the unusual conditions to which the lives of children would be subjected during the high tension period of the war.

*Third*, a Division for the Treatment of Venereal Diseases, planned not only with the hope of ameliorating suffering and protecting America's selective service men, but with the purpose of placing within reach of the poor those specifics which, when properly applied, might lessen the chances of visitation unto the second and third generations and salvage many lives that might otherwise be wrecked.

Throughout the twelve and a half year period the Commissioner of Health received from his Bureau and Division Chiefs, and through them from the field forces throughout the Commonwealth, information of vital importance to the public. The volume of such information arriving in the central office was enormous, and the subdivisions of the Commissioner's executive staff assisted him in coördinating, digesting, abstracting and reflecting back to the public all those essential details helpful in keeping the public fully informed as to results obtained in making them see that the promises held forth at the time of launching any new line of work were being kept.

The difficulties in the way of perfecting such an organization were not always easily overcome. The Governor, as well as each of his three successors, placed entire confidence in Dr. Dixon and gave him full liberty in organization and freedom from political interference. It is but fair to say that not a single important executive appointment was made to gratify political ambition or to satisfy political recommendation. It very often happened, later in the executive work of Dr. Dixon, that the prominent political leader, who felt hurt that his insistent recommendation could not be complied with, was big enough and broad enough to later come back to Dr. Dixon and say, "I felt at the time you refused my request that you were making a mistake in taking the attitude you did concerning the health organi-

zation. I am convinced, however, that you are right and am glad to tell you so."

During the time that has elapsed since the organization of the Department was fairly well launched in 1906 until the end of 1917, 2,640,000 birth certificates, 1,500,000 death certificates, and 840,000 marriage certificates have been received, catalogued, bound, filed and stored in fireproof vaults of the State Capitol, where they are available for all legal and statistical purposes.

Two hundred thousand persons have been quarantined in rural districts for the various communicable diseases, with subsequent sanitary cleansing and disinfection of premises, and breaking the continuous chain of infection leading from farmstead to town and city and back again to farm. One hundred and twenty thousand dairy farm inspections have been made, and 2,500,000 school children in fourth class district schools have been examined with recommendations to parent or guardian for correcting defects.

Two hundred and eighty-four plans for water works and sewage treatment plants have been filed, studied and approved. 2,274 decrees have been issued requiring the installation of sewage works and water works, and 150 separate pollutions have been removed from streams.

One hundred and seven thousand three hundred and sixty-three patients have been treated at the tuberculosis dispensaries. 1,250,348 visits have been made to the homes of these patients for the purpose of giving practical teaching and sanitary instruction. Nearly 30,000 poor patients have been treated and educated at the Department's tuberculosis sanatoria.

The amount of work done in the Division of Laboratories for physicians of the Commonwealth was enormous, more than 20,000 specimens being examined monthly and scientific reports made to the family doctor.

Since the distribution of antitoxin was begun in 1905 until the end of the last statistical year 300,000 packages of diphtheria antitoxin were distributed free to the poor, 2,000 persons have been immunized against tetanus; nearly 50,000 against smallpox; and large numbers of persons were immunized against typhoid fever.

During the twelve and three quarter years' period when Dr. Dixon was Commissioner of Health in the Commonwealth of Pennsylvania there was appropriated to his Department and expended in the promotion of public health, including the treating of the tuberculous sick, more than twenty million dollars of State

funds, and yet no criticism of this expenditure has been uttered. During this period in his official capacity as Commissioner of Health, he superintended activities extending to every municipality in the Commonwealth. He exercised advisory and supervisory control over the many public health organizations in the State, always leading and setting an example in every line of public health work. These many smaller health organizations, recognizing Dr. Dixon as a central figure, and stimulated by his work, exerted themselves to their utmost. The resulting saving of life is shown by the fact that in the year 1906 when the State Health Department was reorganized, the death rate in the State was 16 per thousand, and in 1917 it had declined to 14.7. This indicates a saving of 120,266 lives in the Commonwealth.

As a fitting stamp of approval of the sanitary work of Dr. Dixon, the Pennsylvania State Medical Society, after eleven years of enforcing police law (and sometimes in a drastic way against medical men), elected him to its highest office. He passed away while serving as President of the Society. His death was mourned most sincerely. The editorial notices written after Dr. Dixon's death were most unusual and show how he had inspired the confidence of the people.

DR. CONKLIN.—The addresses to which we have just listened have revealed to us a man of unusual ability and achievements, one who succeeded not merely in one profession but in several, and who has left upon his city, State and nation an enduring impression. "Si monumentum quaeris, circumspice." He died too soon, in the thick of work, in the midst of public service. Now he rests from his labors and his works do follow him. Peace to his ashes, honor to his memory.

ON THE GENERIC POSITION OF *SONORELLA WOLCOTTIANA* BARTSCH.

BY H. A. PILSBRY.

*Sonorella wolcottiana*, described from Palm Springs, a health resort at the foot of the San Jacinto Mountains, not far from the Southern Pacific Railroad, has been known hitherto by the original specimens collected by Mrs. H. T. Wolcott in 1903 and by a small series taken by Messrs. Morgan Hebard and J. A. G. Rehn in 1910. Unfortunately, all of these were dead shells. From the close correspondence of the shell to the *Sonorellas* of Arizona and New Mexico, the species was naturally referred to that genus. The receipt of living specimens taken early in March by Dr. Emmet Rixford of San Francisco, enables me to transfer it to the genus *Micarionta*, chiefly known by coast *Helices*, such as *facta*, *gabbi*, *kelleti*, *stearnsiana*, etc. It appears that a group of this genus has been adapted to the arid interior, where they have assumed the appearance of the desert group *Sonorella*.

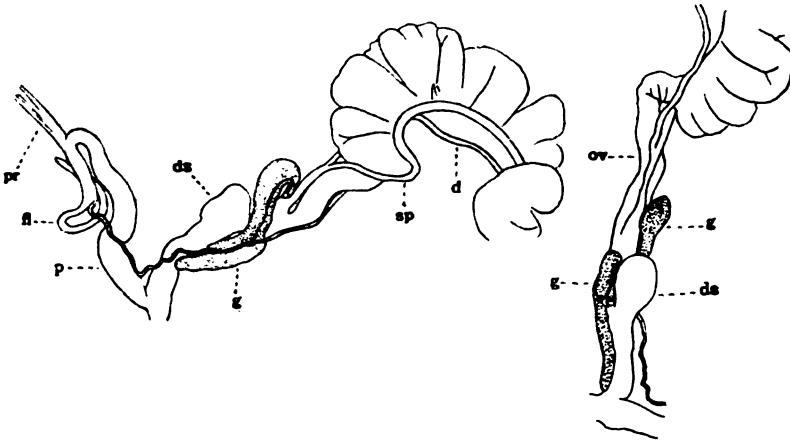


Fig. 1.—Genitalia of *Micarionta wolcottiana*. In the right figure another view of the ♀ organs. *d*, Diverticulum of the spermathecal duct; *ds*, dart sack; *fl*, flagellum; *g*, mucous glands; *ov*, oviduct; *p*, penis; *pr*, retractor of the penis; *sp*, duct of the spermatheca. The mucous glands are shaded to show their forms more distinctly.

The reproductive organs are illustrated for comparison with *Sonorella* and other *Micariontas*. It will be seen that on each side of the



base of the dart sack, the duct of a mucous gland arises. Each duct ascends and expands into a bulb, then is contracted, recurved upon itself, descending, becoming flattened in form of a long, thin-walled gland adhering to the vagina. For the sake of distinctness, these glands and their ducts are shaded in the figures. As usual in the genus, one of the mucous glands rises high over the dart sack, the other being lower, and concealed behind the dart sack in the left hand figure. The spermatheca has an extremely long, thin duct, which bears a long, slender diverticulum. The specimens did not pull well, and the upper part of the oviduct, the albumen gland, spermatheca and ovotestis were broken off.

Length of penis.....	6.5 mm.
“ “ epiphallus.....	5 “
“ “ flagellum.....	7 “
“ “ vagina.....	7 “
“ “ dart sack.....	3 “

Doctor Rixford writes as follows: "About the first of March I spent a few days at Palm Springs, Cal., on the eastern edge of San Jacinto Mountain, and had opportunity to get a few snails. I found only the one variety and no other shells except a small *Physa* which I take to be a common *Physa* of the West Coast. The *Helix* I have not been able to identify. Judging by the number of dead shells, it must be very numerous in that region, but because it had rained shortly before my visit the live shells were much scattered, having left their summer quarters. On the under surfaces of rocks I found markings of large colonies. In this region the rainfall is only an inch or so a year and the summer temperature much above 100 F. The rocks are granitic."

**A NEW CHARACIN FROM PARAGUAY.**

BY HENRY W. FOWLER.

Recently the Academy received a small collection from Senor A. De W. Bertoni, secured at Puerto Bertoni, Paraguay. As this contains several interesting fishes: *Otocinclus vittatus* Regan, *Parodon paraguayensis* Eigenmann, *Phalloceros caudimaculatus* (Hensel) and the Characin belonging to the *Tetragonopterinae* described below, this note has been prepared. The Academy is indebted to Senor Bertoni for these interesting gifts to its Museum.

**BERTONIOIUS** gen. nov.Type, *Bertoniolus paraguayensis* sp. nov.

Preventral region evenly convex. Maxillary slips below preorbital or only about half its upper edge shielded. Upper teeth 5 each side in inner row as in *Moenkhausia*, and outer series in row parallel. Mandibular teeth uniserial. Upper lip covers premaxillary teeth. Gill-rakers lanceolate. All scales cycloid. Predorsal scales uniform in size. Preventral with normal scales. Anal with rather broad basal scaly sheath its entire length. Caudal base covered with large scales. Lateral line complete, slightly decurved, parallel with rows of scales below.

Allied to *Moenkhausia* Eigenmann and *Markiana* Eigenmann. From the former it is distinguished by the second suborbital in contact with the preopercle below, a point in agreement with *Knodus*. It differs from *Knodus* in the 5 teeth each side in the inner upper row, a character in agreement with *Moenkhausia*. *Markiana* Eigenmann somewhat resembles it, but the anal is more scaly and its unequal short lobed caudal is quite different. In *Bryconamericus* the caudal scales are small, not large as in this genus.

One species in the Parama basin. (For Senor A. De W. Bertoni, the accomplished naturalist of Puerto Bertoni, Paraguay.)

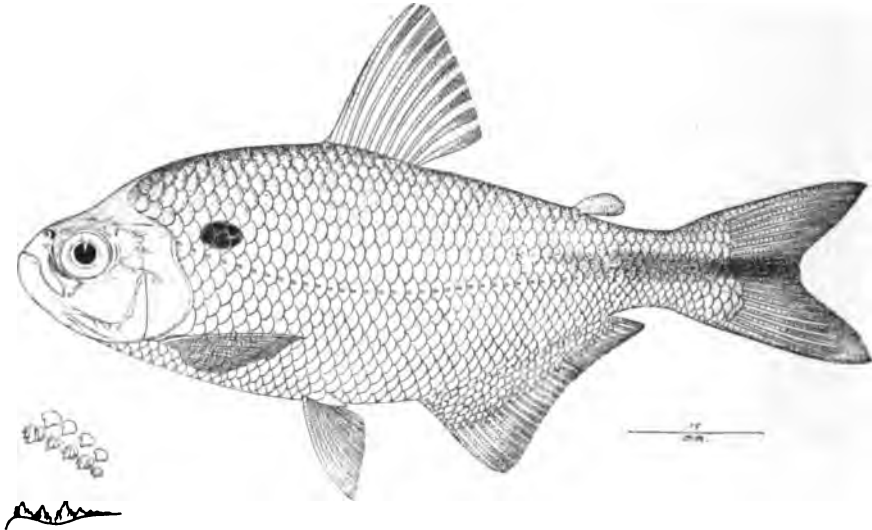
**Bertoniolus paraguayensis** sp. nov.

Head  $3\frac{1}{2}$ ; depth  $2\frac{1}{2}$ ; D. 11, 9; A. 11, 27; P. 1, 11; V. 1, 7; scales 43 in l. l. to caudal base and 3 more on latter; 9 scales above l. l. and 10 below; about 17 predorsal scales; head width 2 in its length; head depth over eye center  $1\frac{1}{2}$ ; snout  $3\frac{1}{2}$ ; eye  $3\frac{1}{2}$ ; maxillary  $2\frac{1}{4}$ ; interorbital

$2\frac{7}{8}$ ; first branched dorsal ray 1; first branched anal ray  $1\frac{1}{8}$ ; least depth of caudal peduncle  $2\frac{1}{4}$ ; upper caudal lobe 1; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{3}{4}$ .

Body elongately ovoid in contour, deepest at dorsal origin, lower profile more evenly convex in front than upper, and well compressed. Predorsal with very slight median ridge, otherwise body edges convex. Caudal peduncle compressed, about long as deep.

Head moderate, upper profile slightly concave and lower little more inclined and convex. Snout convex, short, length half its width. Eye rounded, hind pupil edge little before center in head length. Mouth moderate, horizontal and closed jaws about even.



Lips rather tough, and upper firm, lower broadly free. Teeth alike in jaws, upper biserial with 8 outside and 10 inside, former shorter and tridentate and latter quidentate. Lower jaw with 8 large mostly quidentate teeth and third one each side from front slightly enlarged. Apparently no maxillary teeth. Inner buccal folds thin, inoderate. Maxillary slender, slightly oblique from vertical, extends little below eye, and expansion about 3 in eye. Tongue with free edges, elongate, smooth. Mandible moderately deep or rami little elevated in mouth. Nostrils together, close to upper front eye edge. Interorbital convex. Suborbitals broad, and lowest infraorbital entirely covers cheek. Preopercle edge entire. Suborbitals and opercle each with marginal obsolete striæ.

Gill-opening forward to front eye edge. Rakers  $10 + 16$ , lanceolate, slender, about  $\frac{2}{3}$  of filaments, and latter 2 in eye. Pseudo-branchiæ about half of gill-filaments. Isthmus slender.

Scales cycloid, rather narrowly imbricated, in lengthwise rows parallel with l. l. and become slightly smaller along ventral edge. Caudal with broad basal scaly area, also whole basal extent of anal. L. l. complete, slightly decurved, and each scale with short tube, exposure about half of each scale exposure. Ventral with scaly axillary flap about  $\frac{1}{3}$  length of fin.

Dorsal origin about midway between snout tip and hind edge of adipose fin, first branched ray longest and depressed fin half way to caudal base. Origin of adipose fin little nearer depressed dorsal tip than caudal base, adipose fin about long as eye. Anal with long base, first branched ray highest and fin edge nearly straight, so anal origin nearly opposite hind dorsal edge or about midway between hind preopercle edge and caudal base. Caudal well forked, pointed lobes similar, with lower slightly longer. Pectoral low, reaches slightly beyond ventral origin though not quite to that of dorsal. Ventral inserted nearer anal than pectoral origin, fin reaching latter. Vent close before anal.

Color in alcohol faded dull brownish generally, though back slightly darker than other regions. A pale sheen, as if silvery in life, along middle of side, though narrowing on caudal peduncle side where giving place to slight dusky tint and then continued out on caudal medianly to hind edge as blackish streak. Iris pale slaty. Black ellipsoid spot, little smaller than eye, at shoulder. Dorsal slightly tinged with dusky, and fins otherwise pale.

Length 97 mm.

Type No. 47, 686, A. N. S. P. Puerto Bertoni, Paraguay. Senor A. De W. Bertoni.

Only the type known, quite distinct from the allied species of *Bryconamericus* and *Markiana*, etc. The dentition, shown to the left below in the accompanying figure, is enlarged a little over twice that of the indicated line of proportion for the profile drawing.

## ON A COLLECTION OF ORTHOPTERA FROM THE STATE OF PARÁ, BRAZIL.

BY JAMES A. G. REHN.

The present study is based on material collected at two localities in the State of Pará, and all of which is now in the collection of the Academy of Natural Sciences of Philadelphia. The localities represented are Igarapé-assú and the vicinity of the city of Pará. The former locality is about one hundred and twenty miles east of the city of Pará, off the main line of the railroad between Pará and Brangança and in primaeval forest conditions.<sup>1</sup> The material from this locality was secured by Mr. H. S. Parish of Toronto, Canada, while that from the vicinity of Pará was taken by Prof. C. F. Baker, while attached to the Museu Goëldi at Pará. Portions of both series have already been recorded by the present author in connection with studies of other series of Brazilian material,<sup>2</sup> a total of forty-eight previously known and seven new species having been reported from the series now completely studied. These figures are not included in the totals here given.

In the present paper are discussed one hundred and nine species, representing seventy-one genera, of which twenty-two species and two genera are described as new. The number of specimens represented is four hundred and twenty-one.

## DERMAPTERA.

## FORFICULIDÆ.

*Doru lineare* (Eschscholtz).1822. *Forficula linearis* Eschscholtz, Entomogr., p. 81. [Santa Catharina, Brazil.]

Igarapé-assú. One female.

## ORTHOPTERA.

## BLATTIDÆ.

## Ectobiinæ.

*Anaplecta replicata* Saussure and Zehntner.1893. *Anaplecta replicata* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 25, pl. IV, fig. 12. [Pernambuco, Brazil.]

<sup>1</sup> The general features of this region have been entertainingly described by Dr. Emilie Snethlage, Director of the Museu Goëldi, in a recent number of the Geographical Review (IV, pp. 41 to 50, 1917).

<sup>2</sup> The Stanford Expedition to Brazil, 1911, J. C. Branner, Director. Dermaptera and Orthoptera I. Trans. Amer. Entom. Soc., XLII, pp. 215 to 308, (1916).

The Stanford Expedition to Brazil, 1911, J. C. Branner, Director. Orthoptera II. Ibid., XLIII, pp. 89 to 154, (1917).

Igarapé-assú. Three males.

These specimens fully agree with the description of the species. The status of three unquestionably related forms, i. e. *lateralis* Burmeister, *minutissima* (DeGeer)<sup>3</sup> and *pumila* (Stål), we are compelled to leave in abeyance for the present, although it is quite probable that one at least is the same as the present species. The original descriptions are so brief that little other than the general relationship of the species can be ascertained from them, and the desired more detailed information can only be gleaned from the types or topotypic material.

*Anaplecta bivittata* Brunner.

1865. *A[naplecta] bivittata* Brunner, Nouv. Syst. Blatt., p. 63. [Brazil.]

Igarapé-assú. One male.

This specimen shows some points of difference from the original description, but it is apparently the same species. The head is not wholly rust color, as described, the interocular region of the vertex being blackish brown, while the tegminal maculation does not reach the costal margin of the same, but does, however, border the humeral trunk to the distal squarely truncate margin of the maculation.

This is apparently the first definite locality for the species.

#### **Pseudomopinae.**

*Pseudomops annulicornis* (Burmeister).

1838. *Th[ysocera] annulicornis* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 500. [Bahia, Brazil.]

Igarapé-assú. Two males, four females.

These specimens fully agree with the description of Walker's *Pseudomops deceptura* from an unknown locality, which is considered a synonym of Burmeister's species by Shelford. The original description of *annulicornis* is extremely brief, so little can be learned

<sup>3</sup> We cannot agree with Shelford in his placing this species as a *Holocompsa* (Trans. Entom. Soc. London, 1908, p. 464) from the evidence of the alleged type. The description and figure given by DeGeer are undoubtedly of an *Anaplecta* and it is not at all difficult to see which species are its closest relatives. It seems evident that Shelford did not see the material on which DeGeer based his species and *ad interim* the *Holocompsa* specimen was probably by accident associated with DeGeer's label. DeGeer's original description says of the insect: "Sa couleur est d'un brun noirâtre et très luisant; c'est aussi la couleur de la plaque du corcelet, qui est arrondie, mais dont les deux bords latéraux sont blancs & très transparents." This would clearly apply to an *Anaplecta* of the present group and certain other characters mentioned, as the folding of the wings, make the identification even stronger. The redescription of the "type" by Shelford presents the following features comparable to those quoted above from DeGeer: "Head..... with rufous pubescence. Pronotum fuscous with a recumbent rufous pubescence. Tegmina with marginal area with rufous pubescence." Further comment seems unnecessary.

from it. In all of the specimens the head, the two distal joints of the palpi, the extremities of the femora and tibiae and the tarsi are black or blackish. In no case is the usual dark transverse arcuate bar of the pronotal disk strongly marked.

The only previous records of the species are from Bahia (Burmeister), Pará (Rehn) and Porto Velho, Rio Madeira, interior Brazil (Rehn).

***Pseudomops affinis* (Burmeister).**

1838. *Th[ysocera] affinis* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 499. [Surinam.]

Igarapé-assú. Two females. December, 1911 (one). [One; Cornell University.]

Para and Surinam are the only localities from which the species was previously known.

***Pseudomops angusta* Walker.**

1868. *Pseudomops angusta* Walker, Catal. Blatt. Brit. Mus., p. 81. [Santarem, Brazil.]

Igarapé-assú. One female.

As in material already recorded by us,<sup>4</sup> this specimen differs from the original description in the palpi being entirely black, the femora blackish dorsad and the cerci almost entirely black.

***Ischnoptera crispula* n. sp. (Pl. I, figs. 1-4.)**

A species showing certain affinities with the *inca* group on one hand and with the *marginata*, *castanea-rubiginosa* group on the other. It is apparently allied to *I. hebes* Walker,<sup>5</sup> from Santarem, Brazil, agreeing in the general form, the small size, the widely separated eyes, the setose antennæ, the thinly pilose pronotum and tegmina and most of the color features, but differing in the limbs being in large part fuscous instead of "pale testaceous," in the abdomen having the fourth ventral segment uniformly dark with remainder of the same surface of the abdomen, instead of "tawny" as in *hebes*, while the tegmina have the marginal field, and to a lesser degree the costal margin of the tegmina, pale ochraceous and sharply contrasted with the remainder of the tegmina. The genital features of the present species are quite distinctive. We are able to give only color differences to separate the species, as all the structural features mentioned by Walker for *hebes* are shared by the present species, but our experience with the species of this section of the genus indicates that beyond certain permissible fluctuations color features are well fixed. An

<sup>4</sup> Trans. Amer. Entom. Soc., XLII, p. 224, (1916).

<sup>5</sup> Catal. Blatt. Brit. Mus., p. 122, (1868).

examination of the original material of *hebes* will, in all probability, show the older species possesses characteristic genital features.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) (Acad. Nat. Sci. Phila., Type no. 5316.)

Size very small: form moderately depressed: surface moderately polished, of the head, pronotum, tegmina and limbs with sparse, but distinct, erect hairs. Head for its full width visible cephalad of the pronotum, the outline of the eyes and occiput regularly arcuate; interspace between the eyes very broad, equal to one and one-half times the depth of the adjacent portion of the eye: ocelli elliptical, oblique in position, the interspace between them subequal to that between the eyes; palpi with the third joint slightly longer than the fourth, fifth appreciably longer than the third and moderately inflated, excavate face obliquely truncate for the greater portion of the length of the joint: antennæ faintly exceeding the body in length, rather sparsely but regularly setose. Pronotum subtrapezoid in outline, the greatest width, which is distinctly caudad of the middle, contained one and one-half times in the greatest length of the same; cephalic margin moderately arcuate, rounding into the but weakly arcuate, diverging lateral margins, caudo-lateral angles well rounded, caudal margin moderately arcuate, all the margins distinctly though narrowly cingulate: in transverse section the disk is flattened dorsad and distinctly and roundly declivent laterad; surface unimpressed. Tegmina lanceolate-elliptical, the greatest width contained slightly more than three times in the greatest length of the tegmen, distal section surpassing apex of abdomen by nearly the dorsal length of the pronotum: costal margin moderately arcuate proximad and distad; sutural margin in greater portion straight, distad regularly arcuate to the broad and well rounded apex, which is more costal in position: marginal field relatively narrow and abbreviated; anal field elongate pyriform, reaching to two-fifths the length of the tegmen: discoidal vein with sixteen costal rami, several of the distal ones of which are bifurcate; median vein with four rami (made up by bifurcation of two main rami); ulnar vein with three to four rami, the number of both median and ulnar rami very difficult to determine owing to the anastomosing of the veins in the proximal portion of the discoidal field; anal sulcus regularly arcuate in proximal half, straighter distad except for the short distal arcuation near the junction with the sutural margin; axillary veins fourteen in number, as the usually weak adventitious veins are equal in strength to the usually more pronounced principal veins. Wings with the



costal margin straight oblique proximad, very gently arcuate distad, with a faint flattening at the middle of the arcuation: anterior field very broad, broadly rounded distad; intercalated triangle distinct but small: costal veins eleven in number, in general regularly oblique, simple and non-clavate; medio-discoidal area in general faintly wider than the medio-ulnar area, divided into moderately regular, subquadrate areolæ by thirteen cross-veins; median vein simple, direct, unbranched; medio-ulnar area with similar but less numerous and more oblong areolæ; ulnar vein with two complete and seven incomplete rami; axillary vein with two rami. Sixth and seventh dorsal abdominal segments with the structure characteristic of *Ischnoptera*.<sup>6</sup> supra-anal plate large, semi-ovate, very shallowly arcuate-emarginate mesad; slightly sinuate near the cercal bases, peripheral margin and its vicinity with scattered, erect hairs; ventral surface of the plate with a long dextral, subchitinous tooth, which is directed meso-ventrad: cerci moderately elongate, fusiform, depressed, apex narrowly blunted; subgenital plate moderately asymmetrical, sinistral portion of plate arcuate-emarginate ventrad of the cercus, mesal portion of plate similar, the area between obliquely sinuate-truncate, the sinistral style situated sinistrad on the same section, dextral side of the plate deeply rectangulate-emarginate, the dextral style situated on the apex of the rounded lobe between the median and dextral emarginations; styles short, thick, fusiform, unequal, with distal extremity arcuate aciculate; margin of the plate closely haired, dorsal surface of the subgenital plate having at the base of the dextral style a lamellate, suberect, subchitinous process, the free margin of which is unequally bilobate. Cephalic femora armed ventro-cephalad with a typical *Ischnoptera* spine arrangement.<sup>7</sup>

General color blackish brown, the trochanters, ventral surface of the femora, dorsal surface of the tibiæ and flecks on the tarsi ochraceous-buff. Head with the interocular region faintly reddish; eyes black; ocelli naples yellow. Pronotum with the margins, except for the median section of the caudal margin, narrowly ferruginous. Tegmina with the marginal field and an evanescent edging of the scapular field light ochraceous buff. Wings infumate.

Length of body, 7.6 mm.; length of pronotum, 2.3; greatest width of pronotum, 3; length of tegmen, 7.6; greatest width of tegmen, 2.4.

The type is unique.

<sup>6</sup> See Hebard, Trans. Amer. Entom. Soc., XLII, p. 339 to 340, pls. XVI and XVII, (1916).

<sup>7</sup> See Hebard, Trans. Amer. Entom. Soc., XLII, p. 340, pl. XVII, fig. 1, (1916).

*Ichnoptera castanea* Saussure. (Pl. I, figs. 13, 14.)

1869. *I[chnoptera] castanea* Saussure, *Revue et Magasin de Zoologie*, 2e sér., XXI, p. 112. [Brazil.]

Igarapé-assú. One male.

This specimen fully agrees with the original description, as far as it supplies characters derived from the female sex. As the male genital characters have never been described, the following notes on the same should prove of assistance.

Supra-anal plate moderately transverse, the margin broadly arcuate, appreciably flattened in the middle and there very weakly bilobate, cercal emargination decided, regularly concave, margin between apex and cercal emargination moderately arcuate; surface of plate sub-depressed proximo-laterad, with a distinct, broad, median impression on distal half: distal portion of margin very sparsely haired: ventral surface of supra-anal plate with patches of short, agglutinated hairs on the faint lobes of the distal margin, also meso-laterad on the body of the plate, while a distinct, tuberculiform node is situated immediately mesad of the dextral cercus; immediately mesad of the sinistral cercus there projects ventrad a heavy, claw-like process, which is nearly straight and robust in the proximal two-thirds, thence sharply bent mesad and straight acuminate: from immediately ventrad of the dextral cercus springs an unpaired lamellate, articulate process, a portion of the internal genitalia, the dorsal surface of the same bearing in proximal two-thirds a carinate ridge, the apical section rotated dorsad and weakly rostrate, bearing five distinct teeth: genital hook slender, bent recurved, the apex slightly flattened. Subgenital plate faintly asymmetrical, with dextral, sinistral and median emarginations, between which are short, truncate projections of the margin of the plate; sinistral emargination broad, faintly angled mesad; median emargination regular; dextral emargination small but deep and rectangulate; styles unequal in size and development, the sinistral large, straight proximad, acuminate distad, distal half decurved; dextral style smaller, regularly acuminate, decurved; margin of the plate and styles sparsely haired; dorsal surface of the subgenital plate at base of dextral style with an erect, laterad directed, lamellate lobe, bearing at the internal angle of the apex a distinct, dentiform spine.

*Ichnoptera imparata* n. sp. (Pl. I, figs. 5-8.)

This peculiar species appears to be allied on one hand to *I. castanea* Saussure, and on the other to *I. amazonica* Rehn,<sup>8</sup> but it can be recog-

<sup>8</sup> Trans. Amer. Entom. Soc., XLII, p. 225, (1916).

nized at once by its distinctive form, with tegmina not surpassing the apex of the abdomen, and the type of the male genitalia.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) (Acad. Nat. Sci. Phila., Type no. 5317.)

Size very small: form elongate elliptical; surface moderately polished, sparsely pilose, more heavily so on the limbs. Head exposed cephalad of the pronotum for the greater portion of its width; interspace between the eyes moderately broad, very faintly less than that between the ocelli, which latter are ovate: antennæ one and one-half times as long as the body, closely moniliform, proximal joint faintly shorter than the interspace between the eyes: palpi with the third joint simple, the fourth elongate funnel-shaped, slightly shorter than the third joint, fifth joint moderately inflated, greatest depth at proximal third. Pronotum weakly transverse, the greatest length contained one and one-third times in the greatest width and the latter placed faintly caudad of the middle, general form subtrapezoid; cephalic margin broadly subtruncate, rounding laterad into the lateral margins, which are moderately diverging caudad, faintly arcuate on cephalic two-thirds, thence sharply arcuate to the obtuse caudo-lateral angles; caudal margin arcuato-truncate: disk moderately deplanate, with distinct diverging sulci; narrow lateral portions distinctly deflexed. Tegmina surpassing the apex of the abdomen by less than the length of the pronotum, lanceolate: costal margin moderately arcuate proximad, thence nearly straight to the narrowly rounded apex, which is costal in position; sutural margin straight, except for a short proximal section and distad rounding into the strongly oblique, arcuato-truncate, distal margin: marginal field very narrow, in length nearly equal to two-fifths of the entire tegmen: anal field elongate pyriform, in length equal to about one-half of the tegminal length: costal veins fourteen to fifteen in number; discoidal sectors longitudinal, six in number, with distinct, longitudinal, intercalated nervures and regularly placed transverse nervures, which form rectangulate interspaces; anal sulcus sharply curved distad and joining the sutural margin at a right angle; axillary veins closely placed, with regular intercalated and cross nervures, their structure merged to such an extent that a count is not warranted. Wings falling slightly short of the apex of the tegmina when in repose, greatest width contained one and two-thirds times in greatest length: costal margin regularly arcuate; apex broadly rotundato-rectangulate; peripheral margin more amply arcuate distad than usual: anterior field relatively very broad; intercalated triangle distinct but

small: mediastine vein straight in the greater portion of its length, bearing eight costal veins, remainder of costal veins seven in number, all non-clavate; discoidal vein almost straight; medio-discoidal area broad, divided by sixteen regularly placed, transverse nervures into subquadrate areolets; median vein arcuato-sinuate; medio-ulnar area narrower than the medio-discoidal area, similarly divided, but with veins fewer and less distinct; ulnar vein with one complete ramus, which is bifurcate close to its origin, and three incomplete rami; axillary vein biramose. Dorsal abdominal segments of the type characteristic of *Ischnoptera*:<sup>9</sup> supra-anal plate transverse, lateral margins regularly converging caudad, the distal margin truncate, its vicinity with long, sparse hairs; when viewed from the caudal aspect there is seen to be dextrad, briefly mesad of the cercus, a thick, curved projection, which points mesad, and is distinctly tapering distad, the whole structure well hidden under the margin; cerci relative heavy, rather short, subequal in width for the greater portion of the length, rather abruptly tapering distad, depressed dorsad, rounded ventrad, with a close, adpressed coat of short hairs and scattered, erect, long hairs: subgenital plate moderately asymmetrical; sinistral margin with a broad, deep emargination ventrad of the cercus, relatively short, median section concavo-truncate, dextrad of which is a short, deeply arcuate emargination, with a moderate projection separating it from the oblique subtruncate and then (proximad) arcuate remainder of the same margin; both principal emarginations with their margins somewhat thickened and the plate there appreciably convex in section, between them the plate is concave distad; styles unequal, the sinistral one twice as large as the dextral, situated at the lateral angles of the median subtruncate section, incrassate, tapering, with the apex bispinose, the distal spine larger, decurved, the other spine situated slightly proximad of the apex, straighter; when viewed from the caudal aspect the plate is seen to have an incrassate arm extending mesad from the projection of the dextral margin, this arm reaching to the median line of the body, supplied at the apex with long hairs and on the cephalic face with a number of spines: genital hook sinistral in position, the distal portion sinuate, V-shaped, narrowed at the bend of the structure, slightly thickened and blunt distad. Cephalic femora with ventro-cephalic margin with four large, proximo-mesal spines, these followed distad by a regular series of very short, fine spines; distal spines three in

<sup>9</sup> See Hebard, Trans. Amer. Entom. Soc., XLII, pp. 339 to 340, pls. XVI and XVII, (1916).

number, the extreme distal the larger: median and caudal femora with ventral margins regularly and heavily spined, genicular spine large: caudal tarsi with metatarsus distinctly longer than the remaining joints combined, ventral surface strongly biseriate, pulvilli small.

General color above and on the venter of the abdomen argus brown, paling to antique brown on the veins distad on the tegmina. Head deep blackish fuscous, except for the mouth-parts, labrum and distal half of the clypeus; eyes prout's brown; distal palpal joint weakly washed with mummy brown; ocelli zinc orange; antennæ blackish fuscous, slightly paler proximad and distad. Pronotum with a relatively broad cephalic and lateral border of ochraceous-buff, the bounding line of the two shades appreciably sinuate laterad. Tegmina with the general color strongest at the base of the marginal field, this, in the same area, sharply giving way to ochraceous-buff, which passes distad into a weak shade of the general coloration; distal section of the tegmina very pale, as is the normally covered section of the right tegmen. Wings weakly infusate, becoming ochraceous distad, the veins similarly but more opaquely colored. Abdomen faintly darker than the general dorsal coloration, more deeply infusate laterad, the dorsal abdominal fold ochraceous-buff, surrounded by deep fuscous; styles deep fuscous. Limbs ochraceous-buff, coxæ each with a proximal blotch of fuscous, those of the cephalic coxæ much smaller than those of the other limbs.

Length of body, 7.3 mm.; length of pronotum, 2.4; greatest width of pronotum, 2.9; length of tegmen, 6.4; greatest width of tegmen, 2.2.

The type is unique.

*Ischnoptera clavator* n. sp. (Pl. I, figs. 9-12).

Allied to *I. amazonica*<sup>10</sup> Rehn, from northern Brazil, but differing in the deeper color pattern, more inflated distal palpal joint and the radically different genitalia of the male, the subgenital plate of which bears a relatively large club-like appendage. The supra-anal plate of the female of *clavator* is distinctly U-emarginate mesad, while that of *amazonica* is entire. The species shows relationship to *I. rubiginosa* Walker, having a similarity in the form of the male supra-anal plate, but *clavator* is a larger species with more convergent eyes, a less strongly transverse pronotum, more elongate tegmina and wings, and decidedly different development of the subgenital plate and styles of the male. The female of *rubiginosa* has the

<sup>10</sup> Trans. Amer. Entom. Soc., XLII, p. 225, (1916).

supra-anal plate trigonal with the lateral margins sinuate-emarginate and the apex well rounded and entire, instead of U-emarginate as in *clavator*.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.)  
[Acad. Nat. Sci. Phila., Type no. 5319.]

Size small: form elongate elliptical, strongly depressed: surface glabrous. Head distinctly projecting cephalad of the pronotum: interspace between the eyes very narrow, hardly more than half that between the ocellar spots, which latter distance is subequal to the greatest length of one of the spots, the spots are large, subreniform in outline: eyes with their greatest cephalic depth equal to about one and one-half times the interocellar width: antennæ slightly longer than the body, moderately hirsute, second and third joints together about two-thirds as long as the proximal joint: third palpal joint of moderate length, slightly arcuate; fourth palpal joint two-thirds as long as third, slightly and evenly enlarging distad; fifth palpal joint slightly longer than the third, inflated, sublanceolate, apex subacute. Pronotum roundly trapezoidal, but moderately transverse, the greatest length contained one and one-half times in the greatest width; cephalic margin weakly arcuate, broadly rounding into the diverging, distinctly arcuate, lateral margins, which pass through the obtusely rounded caudo-lateral angles into the arcuato-truncate caudal margin, all margins finely cingulate and supplied with sparse, well-spaced, long hairs, the cephalic margin, however, with a series of short hairs: disk of pronotum weakly arcuate in section, appreciably declivent laterad, the immediate margin slightly reflexed; oblique sulci indicated but slightly irregular in impression, caudal section of disk weakly depressed. Tegmina elongate lanceolate, surpassing the apex of the abdomen by nearly the length of the pronotum, the width at the distal third greater than that at the proximal third: costal margin straight except for a short proximal arcuation and a brief distal rounding to the apex, which is at the tip of the median vein and very narrowly rounded; sutural margin in general straight, except at distal third, where it regularly and broadly rounds to the immediate apex: marginal field narrow, its distal extremity not quite reaching to the proximal third of the tegmen; scapular field moderately wide, subequal in width; anal field elongate pyriform: costal veins very numerous, regular in position; discoidal rami longitudinal, nine in number (aside from the discoidal vein itself), intercalated nervures regular and all connected by closely placed

and generally regular, transverse sectors; anal sulcus impressed, moderately, strongly arcuate distad, jointing the sutural margin faintly distad of the proximal third; axillary veins and their numerous intercalated accessories regularly placed. Wings reaching almost to the apex of the abdomen, broad, their greatest width contained almost twice in their greatest length; costal margin largely straight oblique proximad, gently arcuate distad, the apex well rounded rectangulate and entirely in the anterior field; peripheral margin of the posterior field regularly arcuate, except for the frequent, short, bulging arcuation at the apex of the axillary vein and rami; intercalated triangle very small; mediastine vein largely straight oblique; discoidal vein straight proximad, weakly arcuate distad; costal veins (including the more distinct ones arising from the mediastine vein) twenty-one in number, oblique, non-clavate; medio-discoidal area distinctly narrower than the medio-ulnar area, appreciably narrowing distad, with the transverse rami rather regularly placed, twenty in number, the majority weakly bent arcuate, the areolets generally subquadrate; median vein simple, of much the same curve as the discoidal vein; medio-ulnar area with the transverse rami less numerous than those of the medio-discoidal area, fifteen in number, incomplete costad, the areolets more rhomboid than quadrate: ulnar vein with two complete and seven incomplete rami; axillary vein with two rami diverging slightly proximad of the middle. Abdomen with the disto-dorsal segments having the structure usual in *Ischnoptera*: supra-anal plate in general subquadrate, very faintly transverse; distal margin bisarcuate laterad of a shallow, median, arcuate emargination, the whole margin, but particularly these arcuate portions, supplied with long bristle-like hairs; surface of disto-dorsal section of the plate with two areas of impression:<sup>11</sup> cerci elongate, styliform, acuminate, depressed dorsad, rounded ventrad, strongly hirsute: subgenital plate asymmetrical; free margin sinistrad with an arcuate emargination, in which is placed the sinistral style, mesad with a transverse, truncate section, in the dextral angle of which is situated the dextral style, dextrad of this is a deep acute-angulate emargination, in which is visible an acute, lamellate projection of the internal genitalia, dextrad of this emargination and mesad of the cercus the margin develops an erect, lamellate peg-like process, which projects dorsad of the supra-anal plate when the parts are in their normal position, the apex of this process is covered with erect,

<sup>11</sup> The presence of these areas may not be a normal condition.

agglutinated hairs, certain of which appear spiniform, the remainder of the margin and a large portion of the ventral surface of the plate with long hairs, many of which are bristle-like; sinistral style strongly arcuate, the apex directed laterad and with a number of distinct but short teeth; dextral style very short, decurved, rounded at the apex, with there a number of similar short teeth. Cephalic femora with the ventro-cephalic margin bearing three median and three distal spines, the latter group increasing in length distad, the area between the two groups with a continuous, regularly spaced series of short, piliform spinules, no disto-dorsal genicular spine present: median and caudal femora with a distinct disto-dorsal genicular spine, ventral margins with large, well-spaced spines: arolia distinct; caudal metatarsus faintly longer than the remaining joints combined.

Allotype: ♀; Same data as type. [Acad. Nat. Sci. Phila.]

The following features are those of difference from the description of the type. Interspace between the eyes wider, more than two-thirds as wide as that between the ocellar spots, which area is nearly twice as great as the greatest length of one of the spots; ocellar spots somewhat smaller and less conspicuous than in the male: eyes with their greatest depth but faintly greater than the interocellar width. Abdomen simple: supra-anal plate moderately transverse, arcuate, the chitin with a median V-emargination which is filled with a semi-opaque membrane,<sup>12</sup> dorsal surface of the plate with a distal, medio-longitudinal, carinate fold, the free margin of the plate with numerous long, bristle-like hairs: subgenital plate large, distal margin arcuate-truncate between the cerci. Cephalic femora with the median group of large spines numbering four.<sup>13</sup>

General tone of the dorsal surface clear dresden brown to mars brown, the venter largely fuscous. Head blackish fuscous, the clypeus and mandibles ochraceous-buff; ocellar spots warm buff: eyes mars brown to mummy brown: antennæ clove brown, the proximal joint faintly ochraceous. Pronotum with the disk blackish fuscous, more or less distinctly divided in two by a medio-longitudinal line of kaiser brown to liver brown; broad lateral margins, a connected and narrower cephalic margin and a detached, usually weaker, caudal margin of warm buff to ochraceous-buff, the dark disk

<sup>12</sup> In two paratypic females this membrane is not apparent, the margin being distinctly and clearly V-emarginate. Apparently this soft area is not a permanent structure and may be due to the hardening of exuded body fluids.

<sup>13</sup> Two paratypic females agree with the allotype in the number of these spines, while the type has but three.



appreciably narrower at a point slightly caudad of the middle. Tegmina of the general dorsal color, very pale on the portion of the dextral tegmen concealed when in repose; proximal section of the humeral trunk blackish fuscous; marginal field pale ochraceous translucent, proximad more or less suffused with the blackish fuscous of the humeral trunk. Wings clear hyaline, except for a slight infuscation of the sub-coriaceous region of the costal veins; venation pencilled in prout's brown. Dorsum of abdomen fuscous, paling to bister along the median line; supra-anal plate of male with a russet tinge, the characteristic *Ischnoptera* fold of the male ochraceous-buff; venter of abdomen becoming ochraceous-tawny meso-proximad. Limbs ochraceous-buff, the coxæ fuscous proximad, spines tawny.

Male (*type*): Length of body, 12.6 mm.; length of pronotum, 3; greatest width of pronotum, 3.6; length of tegmen, 11.9; greatest width of tegmen, 3.7. Female (*allotype*): Length of body, 13.5 mm. length of pronotum, 3.2; greatest width of pronotum, 3.7; length of tegmen, 12.3; greatest width of tegmen, 3.3.

In addition to the type and allotype we have examined two paratype females, taken at Igarapé-assú. One specimen, while of the body bulk of the others, has the tegmina shorter (11.5).

**Xestoblatta<sup>14</sup> nyctiboroides** (Rehn).

1906. *Ischnoptera nyctiboroides* Rehn, Proc. Acad. Nat. Sci. Phila., 1906, p. 266. [Demerara, British Guiana.]

Igarapé-assú. January 23, 1912. One male.

This specimen, the second known of the species, fully agrees with the original description except that the ulnar vein of the wings has two complete rami on one wing and but one on the other, one incomplete ramus on one wing and none on the other.

**Neoblattella conspersa** (Brunner).

1865. *Phyllodromia* *conspersa* Brunner, Nouv. Syst. Blatt., p. 106. [Brazil.]

Igarapé-assú. December, 1911; January 13 to 25, February 6, 1912. Twenty-two males, twenty-five females. [Two: Cornell University.]

This interesting series shows that while the blackish punctulations on the tegmina in this species vary greatly in number and intensity they are never entirely absent, and are always placed on thickened nodes on the veins. In the individuals with the greater number of punctulations these are individually larger than in those specimens with a considerably smaller number of the same. The pattern of the disk of the pronotum varies in intensity and completeness pro-

<sup>14</sup> Vide Hebard, Trans. Amer. Entom. Soc., XLII, p. 370, (1916).

portionately with the tegminal punctulations, in occasional specimens being obsolete or completely absent. The pale transverse line ventrad of the eyes varies considerably in degree of definition, but this is not correlated with the variation in intensity of the dorsal surface. The ventral surface of the abdomen is always marked by a medio-longitudinal bar of blackish brown, this varying individually in width and to a less extent in distinctness.

As one of the females bears an oötheca we know that in the present species the egg-case is carried vertically with the suture dorsad.

***Neoblattella titania* (Rehn).**

1903. *Blatella titania* Rehn, Trans. Amer. Entom. Soc., XXIX, p. 267. [Bartica, British Guiana.]

Igarapé-assú. One female.

This individual fully agrees with the type.

***Neoblattella pellucida* (Burmeister).**

1838. *Bl[atta]pellucida* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 498. [Pará, Brazil.]

Igarapé-assú. January 13 to 25, 1912. Two males, three females.

***Caribblatta igarapensis* n. sp. (Pl. I, figs. 15-18.)**

Closely related to *C. fossicauda*<sup>15</sup> Hebard, differing in the larger size (this species being the largest of the genus), more elongate tegmina and in the form of the subgenital plate of the male; this of a similar type in which the dextral portion is but weakly produced, the sinistral portion alone markedly projecting. In the female the distal portion of the subgenital plate is less strongly produced than is normal for the genus, but the apex is broadly rounded, not appearing at all bilobate.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5237.]

Size relatively large (for the genus): form as usual in the genus: surface moderately polished. Head for its whole width visible cephalad of the pronotum; occipital line, when seen from the dorsum, straight; interspace between the eyes broad, the breadth subequal to the greatest depth of the eye, and slightly less than the distance between the ocellar spots; ocellar spots small, oblique, ovate: third joint of palpi elongate, simple, faintly arcuate; fourth joint very faintly shorter than the third joint, regularly though not greatly expanding distad; fifth joint slightly shorter than the fourth joint, moderately inflated, the flexor margin, when seen from the side, regu-

<sup>15</sup> Trans. Amer. Entom. Soc., XLII, p. 177, pl. XI, figs. 13 to 17, pl. XII, fig 17 and 18, (1916).

larly arcuate, the extensor margin faintly sinuate, apex roundly acute, when seen from the side: antennæ slightly surpassing the body in length; proximal joint large, faintly longer than the second and third joints united. Pronotum rounded sub-hexagonal, transverse, the greatest length contained one and two-fifths times in the greatest width, which is placed distinctly caudad of the middle: cephalic margin weakly arcuate, passing by broadly rounded angles into the oblique, diverging and appreciably arcuate cephalic portions of the lateral margins, which strongly round into the caudal sections of the lateral margins; caudal margin arcuato-truncate, rounded obtuse-angulate laterad: broad lateral portions of the pronotum weakly declivent. Tegmina lanceolate, greatest width contained about three and one-half times in the length of the same, when closed they surpass the apex of the abdomen by about the length of the pronotum: costal margin in large part straight, gently arcuate in the area of the marginal field, sharply and briefly arcuate distad; sutural margin in general straight, with a distal oblique, subarcuate third: apex rather narrowly rounded, slightly costal in position; marginal field reaching about to the proximal third, relatively narrow; scapular field very broad, at proximal third of tegmen equal to one-half the entire width of the same, costal veins elongate, straight, oblique, the distal one of the regular series biramose, eleven in number exclusive of the rami of the distal one; discoidal vein furcate distad, one or both forks again furcate; discoidal sectors longitudinal, four to five in number, exclusive of the median vein itself; anal field elongate pyri-form; anal sulcus with its oblique portion nearly straight, reaching the sutural margin at about the proximal third; axillary veins five to six in number. Wings relatively broad: costal margin straight oblique in the greater portion of the proximal half, straight truncate in the region of the costal veins, sharply rounding to the rounded obtuse-angulate apex, which is situated at the apex of the median vein: intercalated triangle distinct, trigonal: mediastine vein simple, with a decided costal clavation at its apex; discoidal vein bifurcate and its divisions again furcate; costal veins ten in number, the distal four of a common origin and hardly clavate, the remainder heavily clavate; medio-discoidal area narrow, dividing into oblong or sub-quadrangle areolets by transverse nervures; median vein simple, largely straight; medio-ulnar area subequal to or faintly narrower than the medio-discoidal area, distad more or less completely intersected by transverse nervures; ulnar vein with two complete rami; axillary vein with three rami originating mesad. Supra-anal plate strongly

transverse, the margin broadly obtuse-angulate with the immediate angle broadly rounded, the median section of the margin supplied with a group of long bristle-like hairs: cerci missing: subgenital plate very similar to that of *fossicauda*, having a large, elongate, quadrate, peg-like projection sinistrad, this, however, being proportionately longer and more compressed than in *fossicauda*; mesad the distal margin is deeply U-emarginate, dextrad of which is a projection less than one-half the length of the sinistral protuberance, dextral margin arcuate: genital hook resembling that of *C. insularis* (Walker), but with the curve of the hook more distad in position. Spination of the limbs typical of the genus.

Allotype: ♂; same data as the type.

Differing from the description of the male in the following features. Occipital line weakly arcuate; interspace between the eyes slightly exceeding the greatest depth of the eye and subequal to the distance between the margins of the antennal scrobes. Supra-anal plate transverse, with a distinct, relatively broad, rounded emargination mesad: cerci greatly surpassing the subgenital plate, tapering, moniliform, apex sharply acuminate: subgenital plate ample, the distal section broad, when seen from the ventral aspect not emarginate or bilobate, weakly channelled when seen from the caudal aspect.

General color above pale old gold, the tegmina and lateral portions of the pronotum semihyaline, the wings almost colorless hyaline with the veins tinted. Ventral surface largely cinnamon-buff to ochraceous-buff. Head of the ventral color, the face with bister bands which in disposition combine features of the patterns of *C. reticulosa* and *craticula*, the ventral facial band clearly defined in the allotype, but not indicated in the type, a detached bister point present at each lateral angle of the clypeal base in the allotype but not indicated in the type; eyes kaiser brown, thickly mottled with bister; antennæ old gold, becoming bister distad. Pronotum with a pattern in bister much like that of *fossicauda* but with the lines more connected and complete, the pattern more intensive and therefore more complete in the allotype than in the type. Wing veins, excepting the costal elevations and radiate veins, old gold, the exceptions bister, the clavations rather weakly so. Dorsum of the abdomen washed with bister laterad, leaving, however, a very narrow, pale margin; venter of abdomen with a proximal median area of bister and narrow submarginal lines of the same color. Tibial spines and the larger femoral spines with their bases surrounded by bister rings.

Type: Length of body, 10 mm.; length of pronotum, 2.2; greatest width of pronotum, 3; length of tegmen, 9.8; greatest width of tegmen, 2.8. Allotype: Length of body, 10 mm.; length of pronotum, 2.3; greatest width of pronotum, 3; length of tegmen, 9.2; greatest width of tegmen, 2.5.

The type and allotype are all the individuals of the species we have seen.

#### Nyctilborinæ.

##### *Paratropes elegans* (Burmeister).

1838. *Ph[oraspis] elegans* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 493. ["Unknown locality," probably Surinam.]

Igarapé-assú. One male, one female.

This species has been recorded from Surinam (Saussure) and Pará, Ega and São Paulo, Brazil (Walker).

#### Epilamprinæ.

##### *Epilampra grisea* (DeGeer).

1773. *Blatta grisea* DeGeer, Mém. Hist. Ins., III, p. 540, pl. 44, fig. 9. [Surinam.]

1903. *Epilampra lucifuga* Rehn, Trans. Amer. Entom. Soc., XXIX, p. 271. [Southern British Guiana.]

Igarapé-assú. January 2 to 23, 1912. Ten males, five females.

The acquisition of this series and the recent re-description of the type of DeGeer's *grisea* by Shelford<sup>16</sup> enables us to place our *lucifuga* as a synonym of this variable species. The material before us exhibits two color forms, one similar to the type of *lucifuga*, the other with the castaneous markings slightly larger and more thickly distributed. In all of the specimens the paired trigonal patches on the pronotum are retained. In none of the specimens is the humeral trunk marked by a solid line, this region having either a series of blotches or almost no infuscation at all.

Apparently this is the only exact Brazilian record of the species.

##### *Epilampra conspersa* Burmeister.

1838. *E[pilampra] conspersa* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 505. [Pará, Brazil.]

Igarapé-assú. One female.

This individual agrees fully with the description given by Saussure and Zehntner,<sup>17</sup> although its identity with Burmeister's species is not so certain. The Burmeisterian description is very brief and is considered by Kirby to represent a form different from that studied by Saussure and Zehntner. Personally we cannot express an opinion, but prefer to use Burmeister's name for this handsome species until the type of *conspersa* has been re-examined.

<sup>16</sup> Trans. Entom. Soc. London, 1907, p. 462.

<sup>17</sup> Biol. Cent.-Amer., Orth., I, p. 64, (1893).

**Blattinæ.*****Periplaneta americana* (Linnæus).**

1758. [*Blatta*] *americana* Linnæus, Syst. Nat., X ed., p. 424. ["America."]

Igarapé-assú. One female.

***Periplaneta australasie* (Fabricius).**

1775. [*Blatta*] *australasie* Fabricius, Syst. Entom., p. 271. ["In nave e mari pacifico et regionibus incognitis revertente."]

Igarapé-assú. January 7, 1912. One female.

**Panchlorinæ.*****Panchlora*<sup>13</sup> *exoleta* Burmeister.**

1838. *P[anchlora] exoleta* Burmeister, Handb. der Entom., II, abth. II, pt. 1, p. 507. [Pará and Bahia, Brazil.]

Igarapé-assú. February 25, 1912. Two males, one female.

***Panchlora bidentula* Hebard.**

1916. *Panchlora bidentula* Hebard, Entom. News, XXVII, p. 221, fig. 1. [Igarapé-assú, State of Pará, Brazil.]

Igarapé-assú. January 17, 1912 (type), no date (paratype). Two males.

**Corydiinæ.*****Melestora minutissima* n. sp. (Pl. I, figs. 22, 23.)**

This is the smallest form of the genus, being decidedly under the size of the three previously known species, i. e., *adspersipennis* and *fuscella* Stål from Rio de Janeiro and *fulvella* Rehn from the Misiones, Argentina. Aside from the much inferior size, it differs from *adspersipennis* in the much less transverse pronotum, in the non-sulcate character of the median area of the same and in the dark and less varied coloration. From *fuscella* the new species also differs in the non-sulcate median section of the pronotum and in the non-pellucid character of the lateral portions of the same. From *fulvella*, with the type of which the new form has been compared, the present species also differs in the less strongly transverse and more ovate pronotum, in the tegminal venation becoming obsolete distad, in the relatively longer caudal tarsi and in the fuscous coloration.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5248.]

Size very small: form elongate ovate, depressed: surface moderately polished, regularly but sparsely clothed with silky pile. Head visible cephalad of the pronotum, the outline of the occiput and head arcuate; interspace between the eyes very broad, uniform in width, which is subequal to the greatest depth of the eye, surface of the inter-

<sup>13</sup> For comments on the important characters for diagnostic use in this genus, as well as the synonymy of many of the nominal species of the same, see Hebard, Entom. News, XXVII, pp. 217 to 221, (1916).

space finely rugulose and with regularly placed impressed pits with fine, diverging radial lines: interspace between the antennal scrobes very faintly narrower than that between the eyes, moderately arcuate in section, glabrous: palpi with the fourth joint very slender proximad, regularly expanding distad, the apical margin obliquely truncate; distal article longer than the fourth joint, broad, greatest width at proximal third, margins regularly converging to the acute apex: eyes with facets clearly defined and slightly elevated individually: antennæ at least as long as the body, the proximal segment short moniliform, subglobose, the joints becoming progressively longitudinal distad, regularly pilose. Pronotum transversely short elliptical, the greatest length contained one and one-fifth times in the greatest width: all margins arcuate, the nearest approach to angulation being the weakly suggested latero-caudal angles: oblique depressions distinct, extending from the medio-caudal section toward the usual position of the latero-cephalic angles, then turning mesad and extending subparallel to the cephalic margin, vanishing caudad before reaching the middle line, the enclosed area moderately bullate, with irregularly placed and irregularly indicated slight transverse wrinkles, no medio-longitudinal impression: lateral sections of pronotum weakly declivent. Tegmina coriaceous, haired as the other portions of the body, lanceolate-elliptical, the greatest width contained three times in the greatest length of the tegmen: costal margin lightly and regularly arcuate; sutural margin straight for the greater portion of the proximal two-thirds, arcuate distad; apex rather broadly rounded; the entire costal margin thickened and finely nodulose cingulate: marginal field occupying about the proximal two-fifths, well developed, moderately wide: six well defined costal veins indicated: discoidal field with six definite longitudinal sectors (including the discoidal vein itself), these sinuate, connected by cross-veins and forming quadrate to oblong interspaces, all obsolete distad, becoming lost in the coriaceous shagreenous condition of that region; anal sulcus distinct, impressed, arcuate proximad, straight oblique distad, joining the sutural margin near the proximal third; anal field elongate pyriform; axillary veins three in number, poorly defined. Wings faintly surpassing the tegminal apices when all are in repose. Supra-anal plate transverse, the free margin sinuate-arcuate: cerci moderately long, robust, subfusiform, the apex rather short acute, the whole subdepressed: subgenital plate asymmetrical, from the sinistral side the margin is developed as follows: obliquely arcuate-emarginate ventrad of the cercus, then developed into an acute, peg-

like process, which is narrowly separated from a median rectangulate projection by a distinct but not deep V-shaped emargination, dextrad of the rectangulate projection the margin is briefly arcuate, then strongly oblique truncate. Median and caudal femora with ventral margins finely spined: caudal tarsi hardly shorter than the caudal tibiae, the metatarsus occupying slightly more than one-half the length of the tarsus: arolia present.

General color mummy brown, becoming buckthorn brown distad on the femora and remainder of the limbs, and blackish-brown on the head and proximal antennal joint. Abdomen becoming auburn meso-proximad. Subgenital plate blackish-brown. Eyes blackish-brown.

Length of body, 6.2 mm.; length of pronotum, 1.5; greatest width of pronotum, 1.7; length of tegmen, 5.3; greatest width of tegmen, 1.7.

The type is unique.

#### *Oxyhaloinæ.*

*Chorisonneura parishi* n. sp. (Pl. I, figs. 19-21.)

This is a most peculiar species, which we are placing in *Chorisonneura* chiefly on account of the peculiar structure of the male subgenital plate. The femora are very weakly spined ventrad, while the general form is distinctly suggestive of an *Anaplecta*, so much so that we are not at all convinced of the proper generic position of the species, the assignment of which is tentative. The insect does not seem to be closely related to any of the described species of *Chorisonneura* and we are unable to give a comparative diagnosis for that reason.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5234.]

Size rather small: form depressed, elongate elliptical: surface moderately polished. Head projecting cephalad of the pronotum when seen from the dorsum: occipital line arcuato-truncate when seen from the dorsum; least interspace between the eyes, which is ventral in position, very broad, subequal to the area between the antennal scrobes; face moderately bullate: palpi with the third joint slender, slightly longer than the fifth joint; fourth joint faintly shorter than the fifth joint, slender proximad and regularly enlarging distad; fifth joint somewhat thickened, elongate elliptical in outline: eyes strongly reniform in basal outline: antennæ slightly exceeding the body in length; third joint nearly twice as long as the second joint, proximal joint moderately enlarged, slightly longer than the third joint. Pronotum transverse, its greatest length contained one and



one-half times in its greatest width: cephalic and caudal margins very faintly arcuate, subparallel, the caudal of greater extent than the cephalic, lateral margins broadly and strongly arcuate, latero-cephalic angles obsolete, latero-caudal angles very faint, greatest width situated slightly caudad of the middle: surface of the disk with a faint, discontinuous, medio-longitudinal impression, also with three pairs of poorly defined impressions, the caudal pair practically delimiting the disk latero-caudad; lateral portions of the pronotum semihyaline, weakly deflexed. Tegmina elongate lanceolate, the greatest width contained about three and one-half times in the greatest length: costal margin moderately arcuate in proximal third, straight thence to the moderately arcuate distal fourth; sutural margin of similar form, but the distal arcuation is somewhat more extensive; apex rounded acuminate, nearly median in position: marginal field of medium width, sharply subdeplanate, extending to the proximal third of tegmen; scapular field broad, comprising but slightly less than half the entire tegminal width; anal field subpyriform, comprising slightly less than one-third the sutural length: costal vein twelve in number, oblique, somewhat sinuate and irregular; discoidal vein bifurcate distad, the sutural ramus sending two rami to the distal section of the sutural margin; median vein in general parallel to the discoidal vein, reaching the sutural margin proximad of the discoidal rami, sending two to three strongly oblique rami suturad; ulnar vein bifurcate; anal sulcus strongly arcuate proximad, straight oblique thence to the apex, which is very briefly arcuate; axillary veins five in number, poorly defined. Wings with the intercalated field relatively large, its axial length about equal to one-third that of the remainder of the wing, strongly arcuate distad, subrectangulate proximad: costal veins eleven in number, the three proximal ones springing from the mediastine vein, the proximal nine all distinctly elongate clavate; discoidal vein straight, simple except for the costal veins; medio-discoidal area broad, its width at broadest point almost equal to that from discoidal vein to costal margin, divided into more or less distinctly quadrate areas by eleven transverse veins; median vein straight except for curving costad toward the discoidal vein near its apex, simple except for several rudimentary rami distad; medio-ulnar area narrow, distinctly less (at broadest points) than half as wide as the medio-discoidal area; axillary vein biramose. Subgenital plate<sup>19</sup> of the slightly asymmetrical type, with the large, compressed

<sup>19</sup> The condition of the material is such that we have refrained from making any effort to ascertain the features of the supra-anal plate.

type of styles, found in a number of species of the genus; form of the plate reading from sinistral portion; first, an infra-cercal, slightly oblique, subtruncate, projecting portion, this rounding into a relatively deep U-shaped emargination to the base of the styles, which are placed in broadly, unequally arcuate emarginations, between which is a slight, acute-angulate projection, dextrad of the styles the margin is developed similarly to the sinistral portion, but the projection is narrower and more acute; styles in length distinctly surpassing the remainder of the subgenital plate, distinctly compressed, subparallel, tapering, ventral margin thickened: cerci elongate, depressed, subfusiform, distad greatly attenuate. Femoral margins with a few weak, short spines; genicular spines strongly developed on median and caudal femora: arolia large.

General color buckthorn brown. Head dull vinaceous-rufous; eyes cinnamon-brown; antennæ with the proximal portion of the dorsal surface lined with mummy brown: palpi clay color. Pronotum dull mars yellow mesad, this flanked by a pair of poorly defined, broad bars of dark auburn, which diverge caudad and fail to reach the caudal margin of the pronotum; lateral portions of the pronotum nearly colorless hyaline. Tegmina with marginal field nearly colorless hyaline; humeral trunk and vicinity dark auburn. Wing weakly washed with buckthorn brown, the inter-marginal costal region washed, and the radiate veins pencilled with mummy brown. Abdomen on both lateral aspects with indefinite marginal bands of mummy brown.

Length of body, 8 mm.; length of pronotum, 1.6; greatest width of pronotum, 2.4; length of tegmen, 6.6; greatest width of tegmen, 1.8.

In addition to the type we have before us a paratypic male bearing the same data as the type. This specimen shows no differences excepting a quadriramosa condition of the tegminal discoidal vein, which has one ramus furcate on one tegmen, and biramosa on the other.

We take great pleasure in dedicating this interesting and aberrant species to the collector, Mr. Parish, to whose energy we are indebted for several extremely interesting and important series of tropical American Orthoptera.

#### MANTIDÆ.

##### Mantinae.

*Acantiothespis eximia* (Pascoe).

1882. *Callimantis eximia* Pascoe, Ann. and Mag. Nat. Hist., (5), IX, p. 423.  
[Nazare, near Pará, Brazil.]

Pará. (C. F. Baker.) One male.

Igarapé-assú. January 19, 1912. Two males, one female.

Kirby<sup>20</sup>, who examined Pascoe's type, considers Saussure and Zehntner's *paraensis* to be the same as *eximia*.

The male has not been previously described. In that sex the general form of the head is similar to that found in the female, but the occipital line is weakly concave and the facial scutellum is slightly shallower, though of exactly the same general pattern. The pronotum is of similar form to that of the female but, naturally, slightly more slender. The tegmina are entirely hyaline except the marginal field and the vicinity of the humeral trunk, which are opaque green. The wings are hyaline with the costal margin rather narrowly washed with pomegranate purple, a longitudinal blotch placed on the caudal two-thirds of the radiate field at about two-fifths the length of the wing from the internal margin, bone brown in color. One of the Igarapé-assú males measures as follows: length of body, 19.8 mm.; length of pronotum, 4.4; greatest width of pronotum, 2.2; length of tegmen, 14; length of cephalic femur, 5.2.

All the known records of the species are from the state of Pará, Brazil.

*Angela quinquemaculata* (Olivier).

1792. *Mantis quinquemaculata* Olivier, Encycl. Méth., Ins., VII, p. 636. [Surinam.]

Igarapé-assú. One male.

This specimen has been compared with a male of the species from Bartica, British Guiana (II-27-1913; H. S. Parish) and agrees in all respects except two. The folded carination of the disto-dorsal abdominal segments is well indicated in the Bartica specimen and not apparent in that from Igarapé-assú. The Bartica specimen is more intensely colored, having the yellow areas between the purplish bars on the wings brighter, but the general weak infuscation of the wings is more extensive in the Brazilian specimen and the distal ferruginous patch on the anterior field of the same is more decided in this individual.

Apparently this is the first Brazilian record of the species.

*Macromantis ovalifolia* (Stoll).

1813. [*Mantis*] *ovalifolia* Stoll, Natuur. Afbeeld. Beschr. Spoken, etc., pp. 58, 77, pl. XIX, fig. 72. [No locality.]

Igarapé-assú. One male.

This specimen has the marginal field of the tegmina hyaline in the proximal two-fifths and viridi-coriaceous distad. Apparently

<sup>20</sup> Synon. Catal. Orth., I, p. 233, (1904).

this is the first record of the genus from Brazil or from south of the Guianas.

#### Miopteryginæ.

*Musonia*<sup>21</sup> *major* Saussure and Zehntner.

1894. *Musonia major* Saussure and Zehntner, Biol. Cent.-Amer., Orth., I, p. 165, pl. X, figs. 17 to 19. [South America.]

Igarapé-assú. Two males.

These specimens have also been compared with a male of this species from Nouveau Chantier, French Guiana, recorded by Chopard.<sup>22</sup> The form of the supra-anal plate of the male has never been described. From our material it is seen to be elongate lanceolate, with the apex rounded and but faintly surpassing the distal margin of the subgenital plate. There is present on the plate a distinct precurrent median carina.

This is the first record of the species from Brazil.

#### Vatinæ.

*Parastagmatoptera flavoguttata* (Serville).

1839. *Mantis flavoguttata* Serville, Hist. Nat. Ins., Orthopt., p. 183. [Cayenne.]

Igarapé-assú. One male.

This specimen is inseparable from males from Nouveau Chantier, French Guiana, determined and recorded by Chopard.

#### ACRIDIDÆ.

##### Acrydiinæ.

*Eomorphopus granulatus* Hancock.

1906. *E[omorphopus] granulatus* Hancock, Genera Insectorum, fasc. 48, Tetriginæ, p. 38, pl. IV, figs. 35 and 35a. [Dutch Guiana.]

Igarapé-assú. January 25, 1912. One male.

*Allotettix peruvianus* (Bolivar).

1887. *P[araleltix] peruvianus* Bolivar, Ann. Soc. Entom. Belg., XXXI, p. 272. [Pumamarca, Peru.]

Igarapé-assú. Four males, one female.

<sup>21</sup> The type of this genus was first fixed by the present author, in February, 1904 (Proc. U. S. Nat. Mus., XXVII, p. 568), as *surinama*. Kirby later (Synon. Catal. Orth., I, p. 276—not earlier than November, 1904) indicated *major* Saussure and Zehntner as the type, an unwarranted and untenable designation, as it was not one of the originally included species. As Giglio-Tos has based his recently proposed generic name *Promusonia* on *surinama* (Bull. Soc. Entom. Ital., XLVII, p. 6, (1916)), it is evident that his name is a pure synonym of *Musonia* as properly restricted. As we have already contended (Ibid., p. 567), the generic name *Mionyz* also becomes a synonym of *Musonia*, although at the date of our previous writing no single type had been selected for it. Kirby, however, indicated (Ibid., p. 276) as its type, *lineativentris* Stål, which is apparently congeneric with *surinama*, in addition being with the latter the original basis of *Musonia*. Certain species which have been referred to *Mionyz* are, apparently, not congeneric with *surinama*, and these will require a new generic name.

<sup>22</sup> Ann. Soc. Entom. France, LXXX, p. 332, (1911).

***Micronotus caudatus* (Saussure).**

1861. *T[ettix] caudata* Saussure, Revue et Magasin de Zoologie, 2e sér., XIII, p. 399. [Guiana.]

Igarapé-assú. Three males, five females.

These specimens are typical of this relatively widely distributed species. It seems to us very probable that Bruner's *Tettix gracilis* from Trinidad<sup>23</sup> equals the present species.

***Apotettix bruneri* (Hancock).**

1906. *Apotettix bruneri* Hancock, in Bruner, Proc. U. S. Nat. Mus., XXX, p. 614. [Paraguay.]

Igarapé-assú. One female.

This specimen is inseparable from Paraguayan and Argentinian individuals of the same sex. The range of the species is much extended to the northward by this record.

***Tettigidea hancocki* Bruner.**

1910. *Tettigidea hancocki* Bruner, Ann. Carneg. Mus., VII, p. 131. [Corumbá, Brazil.]

Igarapé-assú. One male.

This specimen fully agrees with the description of *hancocki*, but in size it is somewhat smaller, showing the following proportions: length of body, 8.8 mm.; length of pronotum, 9.1; length of tegmen, 1.7; length of wing distad of pronotum, 2.5; length of caudal femur, 5.4.

The two localities from which this species are known are widely separated, but doubtless it will be found in suitable situations in the intervening region.

**Proscopinae.*****Proscopia scabra* Klug.**

1820. *Proscopia scabra* Klug, in Nees ab Esenbeck, Horæ Physicæ Berolin., p. 19, pl. III, fig. 2. [Pará, Brazil.]

Pará. (C. F. Baker.) One male.

The male is particularly interesting in having a striking type of coloration, a median supra-clypeal area on the lower face, the ventral section of the genæ, the cephalic supracoxal plate, a wash along each side of the meso- and metapleura and the greater portion of the immediate apex of the abdomen, being yellowish. The species *Taxiarchus paraensis* described by us from Obidos, Amazon River,<sup>24</sup> we find to be a synonym of the present species. The unsatisfactory character of Brunner's generic key and lack of comparable material were largely responsible for the reference of this insect to *Taxiarchus*.

<sup>23</sup> Journ. N. Y. Entom. Soc., XIV, p. 145, (1906).

<sup>24</sup> Entom. News, XVII, p. 332, (1906).

Certain of the genera of the present subfamily do not appear at all natural or, if so, are not properly defined.

The species is known from as far south as Bahia and inland to the upper Amazonian region.

**Acoridinae** (*Truxalinae* of authors).

***Orphulella punctata*** (DeGeer).

1773. *Acrydium punctatum* DeGeer, Mém. Hist. Ins., III, p. 503, pl. 42, fig. 12. [Surinam.]

Igarapé-assú. Two males, one female.

Pará. (W. M. Mann.) One male, one female. (C. F. Baker.)

Three males, seven females.

This series exhibits the usual phases and variations of this plastic and widespread species. But two, these females from Pará, are of the all green phase, while the strongly infuscated phase is represented in the Igarapé-assú and Pará lots. In a relatively large number of specimens the lateral carinae of the pronotal disk show a more or less decided tendency to become obsolete between the first and second transverse sulci.

***Orphulella boucardi*** (Bruner).

1904. *Linoceratium boucardi* Bruner, Biol. Cent.-Amer., Orth., II, p. 84. [Rio Sarstoon, British Honduras; Panama; San Diego, Department of Magdalena, Colombia.]

Igarapé-assú. February 1, 1912 (one specimen only). Six males, two females.

For comments on the synonymy of this species the student is referred to a recent paper by the author.<sup>25</sup>

**Ommexechinae.**

***Ommexecha giglio-tosi*** Bolivar.

1899. *O[mmexecha] giglio-tosi* Bolivar, Revista Chilena Hist. Nat., III, pp. 54, 55. [Caiza, Aguiarenda and San Francisco, Bolivian Chaco.]

Igarapé-assú. One male.

This specimen is inseparable from individuals of the same sex previously recorded by us from northern Argentina, except that the disk of the wing is more glaucous and less azure blue.

**Pyrgomorphinae.**

***Omura congrua*** Walker.

1870. *Omura congrua* Walker, Catal. Derm. Salt. Brit. Mus., III, p. 504. [Pará, Brazil; Amazon Region; Archidona, Ecuador.]

Igarapé-assú. One male.

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<sup>25</sup> Trans. Amer. Entom. Soc., XLII, p. 277, (1916).

Locustinae (*Acridinae* of authors).*Colpolopha obsoleta* (Serville).

- 1831. *Tropinotus obsoletus* Serville, Ann. Sci. Nat., XXII, p. 274. ["Cape of Good Hope."]

Igarapé-assú. One male.

This specimen is inseparable from British Guianan males of the species, which has been recorded from Santarem (Rehn) and Pará (Bruner), Brazil.

*Tropidacris collaris* (Stoll).

1813. *Gryllus (Locusta) collaris* Stoll, Natuurl. Afb. Beschry. Spoken, etc., Trek-springhaanen, pp. 39, register 13, pl. XXIV, fig. 80. [No locality.]

Igarapé-assú. One dated January 17, 1912. One male, two females.

*Stenacris cylindrodes* (Stål).

1860. *Opsomala cylindrodes* Stål, Kong. Svenska Freg. Eugenies Resa, Ins., p. 325. [Rio de Janeiro, Brazil.]

Igarapé-assú. One female.

This specimen is inseparable from south Brazilian material.

*Oxyblepta xanthochlora* (Marschall).

1835. *Gryllus xanthochlorus* Marschall, Ann. Wiener Mus., I, p. 215, pl. XVIII, fig. 7. [Brazil.]

Igarapé-assú. One dated January 17, 1912. Two males, two females.

These specimens are only provisionally referred to this species, as the forms of the genus found in northern South America and their relationship is very poorly understood.

*Mastusia caeruleipennis* Bruner.

1911. *Mastusia caeruleipennis* Bruner, Ann. Carneg. Mus., VIII, p. 86. [Benevides, state of Pará, Brazil.]

Igarapé-assú. Three males, two females.

This species was described from a female, apparently unique. The male sex fully agrees with the important features of the original description, except for the genital characters and those features in which the males of this group show some difference from the female, i. e. smaller size, proportionately narrower interocular space of the vertex, more prominent eyes and slightly more distinct median carina of the pronotum. In size the male specimens before us show the following measurements:

Length of body.....	22.3 mm.	19 mm.	19.5 mm.
Length of pronotum.....	4.4 "	4 "	4.3 "
Greatest dorsal (caudal) width of pronotum.....	2.2 "	2.1 "	2.2 "
Length of tegmen.....	11 "	9 "	10 "
Length of caudal femur.....	13.1 "	12.1 "	13.5 "

The male genitalic characters can be briefly described as follows. The disto-dorsal abdominal segment has the distal margin concave mesad, the concavity delimited laterad by a short black projecting tooth; supra-anal plate of the trefoil type found in this genera group, the paired lateral sections strongly rounded, the median distal section short sublinguiform, the dividing emarginations roundly rectangulate, proximal half of plate with a median sulcus, widening distad; cerci developed as broad plates but slightly surpassing the apex of the supra-anal plate, the dorsal section of the plate strongly impressed and depressed, with the apex slightly recurved on the main portion of the cercus, the lateral section, which is thrown into relief by the impressed and recurved sections, being of the sub-falciform pattern found in the cerci of other species of this group of genera, in which species, however, the cerci are not at all lamellate, but instead show modifications of a simpler cercal type; subgenital plate short, when seen from the lateral aspect blunted, the apex strongly pinched dorsad.

The male sex, and to a lesser degree one of the females, shows certain color differences from the original description. The dorsal coloration is appreciably marked off from the darker lateral bars by narrow lines of dull yellow on the head and pronotum, which are continued caudad from the pallid lines on the tegmina mentioned by Bruner. There is also a dark bar, which varies in solidity, across the ventral sections of the genæ, lateral lobes and, more weakly, the pleura, bordering ventrad the yellow described by Bruner. The face is dull pale olivaceous green in both sexes. The caudal femora are clear oil yellow proximad, passing to oil green distad, with the distal extremity somewhat infuscated.

The number of spines on the external margin of the caudal tibiæ varies from six to seven.

*Tetratonia surinama* (Linnaeus). (Pl. I, figs. 24 and 26.)

1764. [*Gryllus*] *surinamus* Linnæus, Mus. Ludovic. Ulric., p. 146. [Surinam.]

Igarapé-assú. Five males.

Pará. (C. F. Baker.) One male, one female.

This series shows the male sex to have a very great amount of variation in size, and apparently to a certain degree locally in the depth of general coloration; in the Igarapé-assú specimens the dorsal surface of the head and pronotum is fully as dark as the lateral (i. e. ventrad of the narrow pale dorso-lateral lines) areas, while the tegmina are more olivaceous, instead of the same area



on the pronotum and the tegmina being distinctly greenish, as in the Pará individuals.

The size extremes (in millimeters) of the Igarapé-assú males and the single female (Pará) seen are as follows:

	♂	♂	♀
Length of body.....	19.5 mm.	29 mm.	35 mm.
Length of pronotum.....	4.2 "	5.8 "	6.6 "
Greatest dorsal (caudal) width of pronotum.....	2.6 "	3.8 "	4.8 "
Length of tegmen.....	17.6 "	22.7 "	24.6 "
Length of caudal femur.....	13.6 "	18.6 "	19 "

The species has been recorded from Surinam, "Brazil," Coca (Bolivar) and Valley of Santiago (Giglio-Tos), Ecuador. The two latter records may not refer to true *surinama*.

*Tetratænia phila*<sup>28</sup> n. sp. (Pl. I, figs. 25 and 27.)

Allied to *T. surinama* (Linnaeus), but differing in the generally smaller size, less strongly bullate occiput, narrower interspace between the eyes, shorter and proportionately broader fastigium, more prominent eyes, in the more slender and more regularly arcuate male cerci, in the less expanded genicular lobes of the median femora and the small dorsal spine of the same region, in the less produced and more robust caudal femora of the male and in the less strongly contrasted coloration.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5284.]

Size small (for the genus): form in general as in *T. surinama*. Head with the occiput regularly bullate-arcuate ascending, but not as elevated as the dorsal surface of the eyes, weakly carinate mesad, the vertex and fastigium moderately declivent; interspace between the eyes subequal in width to the inter-antennal section of the frontal costa; fastigium nearly twice as broad as long, cephalic margin arcuato-obtuse, faintly excavate near the apex, fastigio-facial angle roundly obtuse when seen from the lateral aspect, face gently retreating, bounding border of the fastigium well indicated; frontal costa not strongly indicated ventrad, failing to reach the clypeal suture, moderately narrowed dorsad at the fastigio-facial angle and again to a smaller degree ventrad of the ocellus, thence subequal in width ventrad, surface biseriate punctate dorsad, faintly sulcate ventrad; lateral facial carinae distinct and gently diverging

<sup>28</sup> From *φίλος*, a friend.

ventrad: eyes prominent, distinctly elevated dorsad of the vertex, in outline broad ovate, in length twice as long as the infra-ocular portion of the genæ: antennæ almost twice as long as the combined length of the head and pronotum. Pronotum subsellate, greatest width (caudad) of the disk contained one and one-half times in the greatest length; cephalic margin of disk gently arcuate with a shallow median emargination, caudal margin obtuse-angulate with the immediate angle narrowly emarginate; prozona about one and one-half times as long as the metazona, the latter closely cribriform-punctate, transverse sulci deeply impressed; median carina faintly indicated on the prozona, severed by all the transverse sulci, distinct but low and not sharply defined on the metazona, lateral angles rounded, faintly more evident on the metazona than on the prozona; lateral lobes with their greatest depth contained one and one-quarter times in their greatest dorsal length; cephalic margin straight oblique, ventro-cephalic angle rounded obtuse-angulate; ventral margin arcuate-emarginate cephalad, obtuse-angulate mesad, straight oblique ascending caudad, ventro-caudal angle rounded; caudal margin moderately concave. Tegmina reaching to the tips of the caudal femora, apex rounded. Wings reaching to the tegminal tips. Prosternal spine erect, conical, acute; interspace between the mesosternal lobes quadrate, internal margins of the lobes straight, interno-caudal angles rounded; metasternal lobes very narrowly separated caudad. Furcula present as short spiniform points, between which and the cercal bases are placed on each side a single similar point, the abdominal segment bearing the same sublamellate expanded over the cercal base: supra-anal plate elongate trigonal, slightly arcuate-emarginate on each side mesad, apex broadly rounded, margins moderately elevated, the median line of the plate finely sulcate proximad, carinate distad: cerci thick at the base, thence tapering to the subequal distal half, moderately arcuate in form, apex blunt, moderately incurved: subgenital plate considerably produced, distal portion strongly compressed with the apex faintly bulbous, this faintly elevated when seen from the lateral aspect. Cephalic limbs as usual in the genus. Median femora with the dorsal genicular teeth short and blunt, the genicular lobes not strongly developed. Caudal femora slightly more than twice as long as the head and pronotum together, rather robust, not surpassing the tips of the tegmina, genicular lobes acute, pattern of the paginæ regular, moderately impressed: caudal tibiæ slightly shorter than the femora, distal two-thirds expanded, margins there distinctly lamellate,

lamellar brush on internal margin thick, external margin with but a few hairs; external margin with six to seven spines, internal margin with nine spines: caudal tarsi with proximal joint strongly depressed.

Allotype: ♀; same data as type.

Differing from the description of the male in the following features. Frontal costa sulcate for but a short distance ventrad of the ocellus, plane thence ventrad: eyes elevated but slightly dorsad of the vertex, in depth about one and one-half times that of the infra-ocular portion of the genæ: antennæ hardly twice as long as the pronotum alone. Pronotum not as sellate as in the male, the dorsal line not at all concave when seen from the side, greatest dorsal (caudal) width of disk contained about one and one-third times in the greatest dorsal length of the same: prozona about one and one-third times as long as the metazona: lateral lobes of the pronotum with their greatest dorsal length very faintly longer than their greatest depth. Interspace between mesosternal lobes faintly broader than in the male, that between metasternal lobes cuneate and at narrowest point about two-fifths the width of the mesosternal interspace. Ovipositor jaws elongate, slender, compressed, margins irregularly denticulate. Median femora of normal type, as usual in females of this genus.

General color of intensive individuals very dark olive on the dorsal and lateral aspects, ventral surface and abdomen olive-yellow to yellowish olive, mottled in both cases with bottle green, metazona of the dorsum of the pronotum washed with ivy green. The usual four lines on the head, pronotum and pleura relatively narrow, the dorsal pair quite narrow, in color these lines are olive-ocher to olive-yellow, paling to cream-buff or primrose yellow where the ventral pairs are connected on the face; pleural spots three in number. Eyes mars brown to prout's brown; antennæ of the general color, in proximal half weakly subannulate with dull ochraceous, tips briefly cream color. Tegmina with the anal vein lined with the continuation of the dorsal pair of pale lines; anal area sometimes weakly washed with bottle green. Wings with the disk china blue, apex and distal half of periphery clouded with fuscous. Cephalic and median limbs of the ventral color, the mottling of bottle green quite marked, the tibiæ subannulate with fuscous; proximal portion of the femora washed with nopal red. Caudal femora with the external, dorsal and internal faces of the general dorsal color, triannulate with aniline yellow, the proximal annulus incomplete, the median one V-shaped on the lateral face,

ventral face aniline yellow or washed with garnet brown, the proximal portion of the femora washed more or less completely with nopal red; caudal tibiae deep slate blue, paler along the margins, an incomplete proximal yellowish annulus, spines yellowish, black tipped; caudal tarsi dull greenish, faintly washed with reddish (this probably more extensive and much stronger in life), internal margin of the two proximal joints lined with black.

In the single recessively colored individual before us the dorsal pale lines are greatly subdued and the femoral bands, particularly the caudal ones, are obsolete, while the general color is less distinctly greenish and in places more brownish. The pale antennal tips and the ventral pair of pale bands are, however, as decided as in the intensively colored specimens.

*Measurements (in millimeters).*

	♂ (Type)	♀ (Allotype)
Length of body.....	18.7	25.4
Length of pronotum.....	4	5.2
Greatest width of dorsum of pronotum.....	2.5	3.9
Length of tegmen.....	15.1	19
Length of caudal femur.....	12.2	15.2

In addition to the type and allotype we have before us two paratypic females, which show structural differences only in the faintly more bullate dorsum of the pronotum of one specimen, which is of the recessive type of coloration noted above. An interesting thing concerning one female paratype is that the left antenna was broken off at the sixth joint some time during the life of the insect, and there has been regenerated distad of that joint a terminal joint much longer and appreciably more bulbous than the other segments, which terminal segment, curiously enough, bears a narrow terminal pale marking. Since writing the above we have had placed in our hands a single female of the species from Albina, Surinam, collected May, 1904, by William Schaus, and belonging to the United States National Museum. This individual is more brownish than the Igarapé-assú specimens, with the pattern recessive in character.

**CHLOROPSEUSTES**<sup>27</sup> new genus.

A member of the Tetratæniæ and allied to *Tetratænia*, *Mastusia* and *Eumastusia*, but completely apterous and in general form strongly resembling species of the Coccineutid genus *Dellia*, from which, however, *Chloropseustes* can be immediately separated by the expanded

<sup>27</sup> From *χλωρος* green, *ψευστης* deceiver.

and marginally lamellate distal sections of the caudal tibiae, as well as by the character of the genitalia of both sexes. The more fully the other features of the new genus are examined, the more superficial the evident resemblance to *Dellia* is found to be. From all of the allied genera *Chloropseustes* can be separated by its apterous condition, its supra-genicular spiniform process and its highly polished surface; from *Tetratania* also in the broadly emarginate caudal margin of the pronotal disk, the more (♂) or less (♀) sulcate frontal costa, the simpler subgenital plate of the male and the absence of the clavation of the distal extremity of the median femora found in the male of *Tetratania*; from *Eumastusia* the new genus differs in the form of the head and general type of the pronotum, as well as sculpture of the same, in the non-compressed male subgenital plate and in the linear, more exerted ovipositor jaws of the female; from *Mastusia* the new genus also differs in the form and sculpture of the head and pronotum, in the emarginate caudal margin of the pronotal disk and in the linear, more exerted, female ovipositor jaws. The coloration of the type species is very distinctive.

*Description of Genus.*—Apterous. Glabrous. Surface of face, genae, occiput, pronotum, pleura and proximal abdominal segment with small, raised but low, callose, white areas. Interspace of vertex narrow; fastigium subdeclivent, sulcate; fastigio-frontal region truncate when viewed from lateral aspect; face retreating; frontal costa distinctly (♂) or weakly (♀) sulcate mesad and ventrad, plane dorsad; eyes prominent in both sexes. Pronotum with three very deeply impressed transverse sulci, no lateral and little trace (in male only) of median carinae; cephalic and caudal margins of disk emarginate mesad; mesonotum not equal to one-third the length of the prozona. Supra-anal plate of male subtrigonal; cerci of male falci-form; subgenital plate short, broad. Ovipositor jaws of female elongate, straight, margins weakly denticulate. Prosternal spine sub-compressed, conical, acute. Mesosternal lobes with interspace slightly longitudinal (♂) or slightly transverse (♀). Metasternal lobes contiguous (♂) or narrowly separated (♀). Cephalic and median femora of male subinflated, cephalic genicular lobe larger than caudal lobe on each femur. Caudal femora with a more (♂) or less (♀) pronounced supra-genicular spine, genicular lobes weakly acute; caudal tibiae expanded distad, with the margins sublamellate, external margin with seven spines, internal margin with nine spines; caudal tarsi elongate, second joint subequal to one-half the length of the metatarsus, third joint subequal to joints one and two together.

Genotype: *C. leucotylus* new species.

*Chloropsenus leucotylus*<sup>21</sup> n. sp. (Pl. I, figs. 28-31.)

Type: ♂; Igarapé-assú, State of Pará, Brazil. January 17, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5287.]

Size small. Head slightly enlarging cephalad of its insertion in the pronotum; occiput roundly inflated and ascending; vertex with interspace between the eyes very narrow, less than the width of the third antennal joint, caudad of the constriction the vertex is lanceolate sulcato-impressed; fastigium weakly declivent when seen from the lateral aspect, distinctly broader than long when seen from the dorsum, the greatest width subequal to twice the width of the proximal antennal joint, fastigium delicately sulcate medio-longitudinally; fastigio-frontal region vertically truncate to between the antennæ when seen from the lateral aspect, face then strongly retreating, weakly concave; frontal costa indicated to the clypeal suture, narrow, weakly narrowed ventrad of junction with fastigium and faintly so immediately ventrad of the median ocellus, surface of costa dorsad plane with a few punctures, ventrad of ventral margins of antennal scrobes deeply but narrowly sulcate; lateral facial carinæ well indicated, divergent ventrad; eyes quite prominent, large, well elevated dorsad of the vertex, in length about twice that of the infra-ocular portion of the genæ; antennæ about three times as long as the pronotum, simple, joints elongate, very faintly enlarging distad. Pronotum weakly sellate in general form, but dorsal line straight, with greatest dorsal length slightly greater than the greatest dorsal width; cephalic margin of disk subarcuate with shallow, broad, median emargination; caudal margin of disk very broadly and faintly emarginate, with a more pronounced, broad, median V-emargination; median carina very weakly and discontinuously indicated on the prozona; transverse sulci very deeply impressed, the caudal one continuous, the others, three in number, severed by the median carina, a supplementary, short, dorsal sulcus placed between sulci one and two; metazona forming no more than one-fourth of the dorsal length of the pronotum; lateral lobes about one and three-fourths times as long as deep, ventro-caudal angle rounded, caudal margin straight; surface of metazona of lobes faintly punctulate. Mesonotum with caudal margin faintly obtuse-angulate emarginate mesad, the surface ascending dorso-caudad into a blunt, tubercular structure: metanotum with a structure similar to that of mesonotum, but the caudal margin is more decidedly obtuse-angulate emarginate. Tegmina

<sup>21</sup> From λευκος white, τυλος knob.

and wings completely absent. Abdomen slightly compressed, weakly carinate medio-longitudinally dorsad, extremity slightly recurved: furcula developed as short, broad, rounded well-separated lobes; lateral sections of the segment bearing the furcula sublamellate and projecting over the lateral face of the cercal base, the margin of these lobes arcuate obtuse-angulate: supra-anal plate moderately produced and constricted trigonal, the apex moderately broad, rounded, lateral margins with the cercal emargination broad, moderately deep and regularly arcuate, distal section of plate slightly deflected ventrad from the plane of the proximal portion of the same, the deflected portion with lateral sulci limiting a median rounded "boss": cerci falci-form, short, not surpassing the apex of the supra-anal plate, proximal portion of the cerci very broad, then tapering strongly to the relatively slender and moderately acute distal portion, the whole cercus placed so as to incline toward the median line of the body: subgenital plate very short, broad, not at all produced, when seen from the lateral aspect rounded, the dorsal margin broadly U-shaped.<sup>29</sup> Prosternal spine moderately compressed conical, acute, arising from a broad base. Interspace between the mesosternal lobes subcuneate, slightly longer than broad: metasternal lobes touching on their caudal half. Cephalic and median femora moderately inflated, appreciably arcuate, cephalic genicular lobe of each of these femora larger than the caudal lobe of the same. Caudal femora about twice as long as the head and pronotum together, surpassing the apex of the abdomen by nearly one-half the femoral length, moderately slender, external paginæ regularly and distinctly sculptured, genicular lobes moderately acute, median section of dorso-genicular margin with a distinct projecting spine: caudal tibiæ very slightly shorter than the femora, distinctly expanded distad, the margins there considerably lamellate, marginal hairs few in number but individually long and regularly disposed, external margin with seven spines, internal margin with eight to nine spines: caudal tarsi not quite one-half as long as the caudal tibiæ, slender, the first and second joints together but slightly longer than the third, the second joint about one-half the length of the first joint, which is considerably depressed.

Allotype: ♀; same data as the type. [Acad. Nat. Sci. Phila.]

The female differs from the male description in the following features. Interspace between the eyes subequal to the width of the second antennal joint, the vertex caudad of the interspace hardly more

<sup>29</sup> The type has this plate compressed, apparently unnaturally so, and we are taking its marginal form from the paratype male, which, apparently, represents the normal type.

than finely sulcate: frontal costa less clearly defined ventrad and with the sulcation weaker and sub-obsolete ventrad: eyes not quite twice as long as the infra-ocular portion of the genæ: antennæ about two and one-half times as long as the dorsum of the pronotum. Pronotum slightly shorter, the lateral lobes about one and one-half times as long as deep. Mesonotum and metanotum with marginal form and tuberculiform structure less decided. Supra-anal plate elongate trigonal, strongly arcuate in transverse section, apex rather blunt, surface non-sulcate: cerci short, blunt, styliform: ovipositor valves exerted, elongate, straight, compressed, apices slightly blunted, lateral margins rather finely denticulate, dorsal surface of dorsal valves weakly canaliculate. Interspace between the mesosternal lobes slightly transverse: metasternal lobes narrowly separated. Cephalic and median femora more slender. Caudal femora with dorsal genicular spine less aciculate.

General color calla green to ivy green, passing into more or less clear oil yellow on the lateral lobes of the pronotum (♂), the genæ and lower face (♂) and rostral region (both sexes). The pale spotting ranges from maize yellow, through creamy white to light green-yellow, and is distributed roughly as follows: three paired spots on face, three to four paired markings ventrad of eyes and on genæ, a paired series of eight spots following the usual position of lateral pronotal carinæ extending from eyes to caudal coxæ, another paired series extending from mesonotum to and over dorsum of third to fifth proximal abdominal segments, ventral section of lateral lobes of pronotum with three paired dashes; all these markings placed on strumose tubercles or ridges. Fastigium of male distinctly, of female weakly; pale lemon yellow: antennæ of the color of the face, infuscated distad: eyes mars brown to russet. Abdomen of male occasionally yellowish disto-ventrad: furcula, edge of expansion of disto-dorsal abdominal segment and tips of cerci of male black. Caudal femora with distal extremity and adjacent section of tibiæ cadmium orange to cadmium yellow, strongest on the genicular arches and weakly tinged with the general greenish on the lobes and dorsum: caudal tibiæ with spines black-tipped: caudal tarsi with pulvilli pads scarlet red in some specimens, yellowish (possibly faded) in others.

*Measurements (in millimeters).*

	♂ (Type)	♀ (Allotype)
Length of body.....	13.6	17.8
Length of pronotum.....	2.9	3.1
Greatest (dorsal) width of pronotal disk .....	2.3	2.8
Length of caudal femur.....	10.3	1.6



In addition to the type and allotype we have before us a paratype pair (one—the male—dated January 17, 1912), which show no noteworthy differences from the type material, except that the male has the general coloration more olivaceous, but this we feel is due to drying.

*Bucephalaeris falsoifer* n. sp. (Pl. I, figs. 32, 33.)

Apparently a near relative of *B. corallipes* Bruner,<sup>30</sup> from Corumbá, Brazil, agreeing in the robust form, the closely veined tegmina and the coral red caudal tibiae. The new form differs, however, from *corallipes* in the female sex (the only one known of *corallipes*) having the head higher than wide, in the eyes being less than twice as long as the cephalic margin of the cheek, in the fastigium being distinctly broader than long, in the unbanded pronotum and in the longer tegmina.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5288.]

Size small: form robust: surface of face, lower portion of genæ, pronotum and pleura closely but not very deeply cribroso-punctate, occiput very shallowly punctate. Occiput arcuato-bullate, well elevated dorsad of pronotal level, at highest point faintly flattened; interocular portion of vertex very narrow, hardly more than one-fourth the width of the proximal antennal joint, weakly sulcate in caudal section; fastigium very faintly declivent, the greatest length subequal to the greatest width, in general form pentagonal, the cephalic margin strongly truncate and appreciably cingulate, the surface impressed, weakly nodulose and with a short, rather fine, medio-longitudinal carina: frontal costa dorsad four times as broad as the interocular space and subequal in width ventrad to the median ocellus, ventrad of which the margins are strongly constricted, then diverging an equal amount and obsolete ventrad of this point, the interantennal section of the costa is excavato-sulcate, distinctly punctate, surrounding the ocellus the surface is impresso-punctate, thence faintly sulcate for a short distance and then passing into the punctate face: lateral facial carinae indicated, but developed only as an angle of the face, moderately diverging ventrad, punctate as the face: eyes quite prominent, more than twice as long as the infra-ocular portion of the genæ, in basal outline broad ovate, slightly flattened cephalad: antennae lacking. Pronotum narrower than the caudal width of head, faintly constricted mesad, the greatest dorsal width of disk

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<sup>30</sup> Ann. Carneg. Mus., VIII, p. 93. (1911).

very slightly less than the greatest dorsal length: cephalic margin of disk obtusely produced with a very broad, shallow emargination: caudal margin of disk very broadly obtuse-angulate: median carina faintly indicated cephalad, more distinctly so on the metazona, obsolete mesad: transverse sulci well impressed, metazona slightly more than one-half of the prozonal length: lateral lobes with the greatest dorsal length subequal to the greatest depth; cephalic margin of lobes straight, slightly oblique, ventro-cephalic angle nearly rectangular, ventral margin obliquely concave-emarginate cephalad, median angle distinct but obtuse, this margin obliquely subarcuate caudad, ventro-caudal angle obtuse, caudal margin straight, vertical. Tegmina reaching to the apex of the supra-anal plate, moderately broad, distal four-fifths weakly tapering, apex rounded; venation close, particularly proximad. Wings reaching to the tips of the tegmina, very broad, the greatest width contained one and two-fifths times in the greatest length: distal section of anterior and portion of radiate fields subtruncate. Prosternal spine very robust, short, rather blunt, faintly transverse compressed: interspace between the mesosternal lobes with cephalic width faintly greater than the depth, the caudal width very much greater, the interspace regularly narrowing cephalad, median width of interspace very faintly less than that of one of the lobes, ventro-internal angle of the lobes broadly obtuse: metasternal lobes touching caudad. Supra-anal plate with the greatest proximal width subequal to the greatest length, lateral margin subparallel proximad, then moderately and regularly narrowing, distal extremity rather broad, arcuato-truncate, the surface with a pair of shining black tubercles placed mesad at the distal third, proximad the same plate has indications of a medio-longitudinal impression, flanked laterad by a pair of low rounded ridges; margins slightly thickened and elevated: cerci robust, flattened and broad proximad, in general form subfalcate, the tip directed dorsad, strongly tapering from the broad base to the median section, thence weakly tapering to the subacute apex; when viewed from the dorsum the general form of the cercus is straight proximad, then incurved and last with the distal fourth straight, the arcuate distal margin of the broad proximal portion bears several blunt teeth: pallium<sup>31</sup> greatly produced in an erect, distad compressed, falciform process considerably surpassing the subgenital plate, in form this process is gently tapering with a moderately acute apex: subgenital plate short, well

<sup>31</sup> See Scudder, Proc. U. S. Nat. Mus., XX, p. 8, (1897).

rounded when seen from the side, the dorsal free margin V-shaped, the apex faintly rostrate produced, the proximal section of the V-form of the margin slightly embracing the ventral ridge of the pallium. Cephalic and median limbs moderately robust. Caudal femora moderately robust, very faintly shorter than the tegmina, the greatest depth contained three and one-half times in the length of the same, genicular lobes moderately acute, external face regularly patterned: caudal tibiæ slightly shorter than the femora, armed on the external margin with six spines, internal margin with eight spines: caudal tarsi very slender and elongate, the proximal and second joints subequal in length.

Allotype: ♀; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila.]

Differing from the description of the type in the following features. Size medium. Interocular portion of the vertex slightly wider than the proximal antennal joint, weakly sulcate: fastigium distinctly but not strongly transverse: frontal costa twice as wide as the interocular portion of the vertex, of similar structure to that of the male but the broad portion is plane and non-sulcate, roughly biserial punctate, ventrad of the ocellus even more strongly constricted and sulcate than in the male, thence obsolete: eyes less prominent than in the male, one and two-thirds times as long as the infra-ocular portion of the genæ, in basal outline slightly broader proportionately than in the male: antennæ nearly twice as long as the head and pronotum together, very slender, filiform. Pronotum with the median carina obsolete except on the metazona, where it is weak but distinct: lateral lobes with the greatest depth very faintly greater than the greatest dorsal length of the same. Interspace between the mesosternal lobes with its cephalic width equal to about one and one-third times the greatest length of the same, the form of which latter expands caudad: metasternal lobes separated by an interspace which at its narrowest point (caudad) is subequal to its greatest length. Ovipositor valves robust, short, the external margins of the dorsal valves crenulate.

General color of the female saccardo olive, becoming weakly mummy brown on the dorsum of the pronotum and faintly so on the face; of the male on the head, pronotum and pleura dusky olive-green, on tegmina buffy citrine. Eyes cinnamon-brown (♂) to prout's brown (♀); antennæ fuscous, becoming black distad, with the extreme apex narrowly vinaceous-rufous, proximal joint more (♂) or less (♀) completely raw sienna. Wings very weakly washed

with fuscous, this more apparent along the costal margin and broadly around the periphery, veins fuscous. Abdomen dresden brown (♂) to brownish olive (♀), the ventral surface faintly more greenish; distal section of the margin of the male supra-anal plate, raised points on the same and distal extremity of the cerci black. Cephalic and median limbs of the general coloration: caudal femora hellebore green (♀) or light hellebore green (♂), the distal extremity english red (♂) to mahogany red (♀), the genicular arches weakly greenish, in the female this weakly suffusing the lobes as well: caudal tibiæ and tarsi nopal red, spines black tipped.

*Measurements (in millimeters).*

	♂ (Type)	♀ (Allotype)
Length of body.....	17.6	25.8
Length of pronotum.....	3.4	5
Greatest dorsal width of pronotal disk.....	2.8	4.4
Length of tegmen.....	11	14.8
Length of caudal femur.....	10.5	14

The type and allotype are the only specimens of this species we have seen.

*Vilerna æneo-oculata* (DeGeer).

1773. *Acrydium æneo-oculatum* DeGeer, Mém. Hist. Ins., III, p. 502, pl. 42, fig. 11. [Surinam.]

Igarapé-assú. One male.

This specimen is somewhat smaller than British Guiana individuals of the same sex, but is clearly the same species. This Guianan type is known to range south as far as Chapada, Matto Grosso and Rio de Janeiro, Brazil.

*Abraeris dilecta* Walker.

1870. *Abraeris dilecta* Walker, Catal. Dermapt. Salt. Brit. Mus., IV, p. 642. [Santarem, Brazil.]

Igarapé-assú. January 17, 1912 (one). Two females.

These specimens are inseparable from a cotypic female of the synonymous *meridionalis*<sup>21</sup> from Demerara, kindly loaned by Prof. Bruner.

*Abraeris cæruleipennis* (Bruner).

1900. *Jodacris* (?) *cæruleipennis* Bruner, Second Rep. Merchants Loc. Invest. Comm. Buenos Aires, p. 68. [Asuncion, Paraguay; Territory of Formosa, Argentina.]

Pará. (C. F. Baker.) One male, one female.

<sup>21</sup> See Rehn, Trans. Amer. Entom. Soc., XLII, p. 294, (1916).

Igarapé-assú. January 17 and February 1, 1912. Three males, six females.

These specimens have been compared with a typical pair, a female from Asuncion, Paraguay and a male from San Bernardino, Paraguay, loaned by Prof. Bruner, from which they show no important differences, although they are rather different in coloration. The Pará female has the base color pale ochraceous, with no distinct markings on the body, and the external face of the caudal femora unmarked. The male from the same locality has a decidedly varied pattern of the usual contrasted type of the genus, and a distinct oblique dark bar on the external face of the caudal femora, which marking extends to the base as a fine line. The Igarapé-assú males are duller and darker than the Pará male, but are much more variegated than the females. The external femoral bars are present in all of these, continued to the base by a fine line in one. The Igarapé-assú females are very dark and dull, very little contrasted and with the pale paired thoracic lines completely or nearly completely effaced. The color wash of the proximal portion of the wings in all the specimens, as in the typical material, is more bottle green than "blue" as originally described. The same is true of material from other localities in Paraguay and southern Brazil. The ventro-external face of the caudal femora is variable in the extent to which it is suffused with fuscous or blackish. It is always touched with darker in the punctations of the distal two-thirds of the area, which tendency becomes more pronounced and extensive until in the extreme condition that section is almost uniformly colored, but it is never as sharply defined laterad, as solid, or as solid to the base of the femur as in *nebulosa*, *chapadensis*, *dilecta* and *obliqua*. This feature is the one referred to by us as showing variability in the coloration of this margin.<sup>32</sup>

***Osmilia flavo-lineata* (DeGeer).**

1773. *Acrydium flavo-lineatum* DeGeer, Mém. Hist. Ins., III, p. 497, pl. 42, fig. 4. [Surinam.]

Igarapé-assú. January 17, 1912 (one). Thirteen males, twelve females, one juv. male, one juv. female.

These specimens have the disk of the wing more bluish green than in typical individuals of *flavo-lineata*, in which the same area is yellowish, although with a green tinge, the present specimens being

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<sup>32</sup> Proc. Acad. Nat. Sci. Phila., 1907, p. 186, (1907). The material there recorded as *signatipes*, as we have shown elsewhere (Trans. Amer. Entom. Soc., XLII, p. 294, (1916)) belongs to *cæruleipennis* and *chapadensis*.

terre-verte as opposed to olive-yellow (Ridgway). The bluish tone, however, is more nearly that of typical *flavo-lineata* than the dark tyrian blue (Ridgway) of *violacea* (Thunberg). We refer the Igarapé-assú series to *flavo-lineata*, but do not consider it typical, as we do material from lower Amazonia and the Guianas. It is possible that *flavo-lineata* and *violacea* may be geographic races of the same species and the present series may show a step in the intergradation, but until more material from a number of additional localities is in hand this cannot be more than suggested. The present series shows the usual amount of structural and general brownish color variation in tone and tegminal maculation found in forms of this genus. We feel that this genus should be placed near *Abracris*, to which it is undoubtedly close in relationship.

***Sitalces ovatipennis* Bruner.**

1908. [*Sitalces*] *ovatipennis* Bruner, Biol. Cent.-Amer., Orth., II, p. 291.  
[British Guiana.]

Pará. (C. F. Baker.) One male, one female.

Igarapé-assú. Three males, three females.

This material has been compared with paratypic specimens from Bartica, British Guiana. While they are always minute the tegmina vary greatly in their exact shape and relative size. There is quite a little variation in the extent to which the blackish of the post-ocular regions and lateral lobes suffuses the dorsum of the thoracic segments and the proximal abdominal segments. This is continuous across the dorsum in some individuals, except for the pale longitudinal lines, and in others is there completely replaced by olivaceous. This is always correlated with general pattern depth and the two represent intensive and recessive extremes.

The species is here first recorded from Brazil.

***Sitalces jugatus* n. sp. (Pl. I, figs. 34, 35.)**

A striking apterous species belonging to the section of the genus containing *S. apterus* (Scudder),<sup>33</sup> *debilis* Rehn and probably others. From *apterus* it differs in the slightly narrower dorsal section of the frontal costa in the female, in the larger auditory tympanum, more slender shaft of the cercus in the male, in the relatively shorter and more robust caudal femora of the male, the more slender caudal tarsi of the same sex and in some difference in the color pattern of

<sup>33</sup> We have examined one male and one female of the original one male and two females of this species, which was described as an *Ommatolampis* (Proc. Boston Soc. Nat. Hist., XVII, p. 273, (1875)), and find it is a *Sitalces*. Its relationship to *jugatus* can be determined from the above diagnosis.

the male. The latter feature consists of the pale callose area in *jugatus* being present only on the pleura, while in *apterus* the ventral portion of the lateral lobes is of similar character.

From *debilis* the new species can be readily separated by its more finely rugoso-punctate surface, much more declivent fastigium, more prominent eyes, less apparent median carina of the pronotum, more elongate auditory tympanum, less strongly carinate dorsal line of the abdomen, stouter female cerci, the more acute extremity of the prosternal process, the less decidedly serrate character of the ventral margin of the caudal femora and the reddish brown coloration. As the male of *debilis* is unknown we cannot compare that sex. Bruner's *nudus* from Santarem, may be closely related, but such information as we are able to secure from his very incomplete and not at all convincing remarks on that species seems to point to their being different.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5291.]

Size large (for the genus); form robust; surface of head largely, of dorsal thoracic and single proximal abdominal segments strongly, ruguloso-punctate, other proximal abdominal segments faintly sculptured dorsad. Head with the occiput not elevated dorsad of the pronotum, distinctly declivent to and including the vertex and fastigium; interocular width of the vertex very narrow, equal to less than one-half of the interantennal width of the costa, finely sulcate; fastigium rather short, broader than long, cephalic bounding margin of the impresso-punctate surface rectangulate, with a fine median continuation of the sulcus of the vertex: frontal costa faintly produced between the antennal bases, fastigio-facial angle obtuse, facial line considerably retreating, dorso-ocular section of the costa subequal in width, broad, wider than the proximal antennal joint, non-sulcate, thickly punctate, surface impressed about ocellus, the margins of the costa compressed immediately ventrad of the same, briefly sulcate, thence costa is obsolete: eyes quite prominent, ovate in basal outline, the length twice that of the infra-ocular portion of the genæ: antennæ filiform, elongate, in length twice as long as the head and pronotum together. Pronotum sub-cylindrical, moderately expanding caudad, the greatest caudal width of the disk subequal to the dorsal length of the same, in transverse section faintly tectate: dorsal margin of pronotal disk arcuate produced, faintly and broadly emarginate mesad; caudal margin subtruncate with a very broad and shallow median emargination; median carina faintly and rather irregularly

indicated, no trace of lateral carinæ on shoulders; transverse sulci distinct, but rather finely and narrowly impressed, metazona hardly more than a fourth the length of the remainder of the pronotum: lateral lobes with their greatest depth subequal to two-thirds of the greatest dorsal length of the same; cephalic margin oblique, ventro-cephalic angle rounded obtuse, ventral margin distinctly arcuato-emarginate oblique cephalad, median angle rounded obtuse, caudal section of the ventral margin oblique arcuato-truncate, ventro-caudal angle broadly rounded obtuse. Tegmina and wings absent. Proximal abdominal segment with distinct lateral subcircular auditory tympani. Prosternal spine moderately elongate, erect, conical acute: interspace between the mesosternal lobes quadrate, smaller than one of the lobes; metasternal lobes narrowly separated caudad: surface of mesosternum and metasternum more or less shagreenous, the cephalic half of the mesosternum strongly and closely so. Disto-dorsal abdominal segment with the furcula represented by a pair of the merest nodes, between which the segment is moderately emarginate: supra-anal plate elongate trigonal, apex narrowly rounded, lateral margins with a weak shoulder at two-fifths the length from the base, surface with a broad medio-longitudinal sulcus on proximal half, a pair of inter-marginal, straight, converging impressions, which on account of the shoulder on the lateral margin are more removed from the latter proximad than distad, and the distal area enclosed by the impressions faintly elevated and its surface weakly impressed: cerci short, rather robust, when seen from the dorsum compressed, having the proximal half straight and the distal section directed obliquely meso-caudad, when seen from the lateral aspect having the proximal half deep and weakly narrowing distad, a short, blunt tooth present ventrad on the external face at the point of flexure of the cercus, the distal half narrowing to the blunt but acuminate apex, ventral margin of the distal half with a distinct, blunted but acuminate tooth, this much like the true apex in character: subgenital tooth simple, hardly produced, free margin distinctly emarginato-truncate mesad, the lateral angles being low nodes. Cephalic and median femora robust, inflated, the median ones particularly so. Caudal femora about twice as long as the head and pronotum together, moderately robust, the greatest width contained three and one-half times in the greatest femoral length; dorsal carina with a series of distinct, spaced serrations and an intercalated series of serrulations, ventral carina similarly but more decidedly armed, particularly distad; pagina evenly and deeply engraved; genicular lobes with the distal portion of the



ventral margin distinctly concave, apex bluntly acute-angulate: caudal tibiæ slightly shorter than the femora, moderately sinuate, faintly expanded distad; external margin with seven spines, internal margin with nine spines: caudal tarsi slender, elongate; metatarsus and second joint subequal in length to the third joint.

General color of the dorsum of the thoracic and proximal abdominal segments pale morocco red. General color of the head and abdomen oil yellow, on the occiput and postocular region of the head dull blackish green: venter aniline yellow; cephalic and median femora light cadmium, passing to pyrite yellow on the tibiæ; caudal femora sulphine yellow proximad, passing regularly to olive-green distad; caudal tibiæ and all tarsi olive-green; mesopleura with a decided subcircular spot of buff yellow at the base of the median femora. The clypeal suture and the ventral margin of the genæ are lined with black and the antennal fossæ washed with the same; antennæ of the color of the face proximad, passing to bay mesad and distad; eyes burnt sienna. Abdomen with the proximal segments margined with black, the median segments with paired circular to ovate black spots disposed along the median line; disto-dorsal abdominal segment lined with black next to the supra-anal plate, the extreme tip of the latter similarly blackened; cerci with the points black tipped. Caudal femora with the genicular arches black and a cloud of similar character crossing the base of the genicular lobes; caudal tibiæ with the spines black tipped.

Allotype: ♀; same data as type. [Acad. Nat. Sci., Phila.]

The characters here discussed are supplementary to those given for the male sex. Form very robust: sculpturing as in the male but more decided on the abdominal segments. Interocular width of the vertex slightly more than one-half the interantennal width of the frontal costa, weakly sulcate to bisulcate caudad: fastigium nearly twice as broad as long, cephalic bounding margin of the impresso-punctate surface, obtuse-angulate: frontal costa thickly impresso-punctate dorsad, faintly narrowed at junction with fastigium: eyes slightly less prominent than in the male, their length nearly twice that of the infra-ocular portion of the genæ: antennæ about one and one-half times as long as the head and pronotum together. Pronotum with the greatest caudal width of the disk slightly greater than the greatest length of the same, in transverse section arched: cephalic margin of pronotal disk hardly emarginate, caudal margin less distinctly emarginate than in the male; transverse carina well indicated but more delicate than in the male: lateral lobes slightly deeper in pro-

portion to the length than in the male. Prosternal spine more aciculate than in the male: interspace between the mesosternal lobes slightly transverse, subequal in width to one of the lobes; metasternal lobes separated caudad by a width equal to one-half that between the mesosternal lobes; surface of the sternum punctate instead of shagreenous. Abdomen distinctly carinate mesad to the penultimate segment: supra-anal plate subtectate in section, elongate trigonal in general form, distal section moderately produced caudad with the apex broadly rounded, proximal half with a distinct medio-longitudinal impression, laterad with distinct carinae, which form the proximo-lateral point of the plate thence strongly converge to the median (longitudinal) section of the plate, represented distad by parallel rounded shoulders, ventro-laterad of which the plate is subcompressed: cerci short, broad at base, tapering, the apex blunted: ovipositor jaws moderately compressed, dorso-lateral margins of the dorsal valves faintly and irregularly crenulate. Cephalic and median limbs normal, not inflated as in the male, rather short. Caudal femora as in the male but differing in the ventral carina having smaller but more numerous teeth.

General color of head, thoracic and abdominal segments and cephalic limbs bay, shading to auburn in places, the venter passing to mummy brown. Fastigium sanford's brown; eyes bronzy argus brown; antennae of the general color, paler proximad; clypeal suture black mesad and laterad, the paired black spots found on the fourth fifth and sixth segments in the male represented by smaller and weaker dots. Median limbs paler than the cephalic ones, more yellow ochre. Caudal femora bay with the dorsal face sanford's brown, the genicular arches black, the lobes blackish with a decided green tinge; caudal tibiae and tarsi cedar green, the distal portion black, the spines black tipped.

*Measurements (in millimeters).*

	♂ (Type)	♀ (Allotype)
Length of body.....	17	21.4
Length of pronotum.....	4	4.3
Greatest dorsal (caudal) width of pronotal disk.....	3.5	4.7
Length of caudal femur.....	11.4	12.5

In addition to the type and allotype we have examined four male and two female paratypes. Of these one male bears an exact date, January 21, 1912. The series is quite uniform in coloration, shows

no noteworthy variation in structure and exhibits but a negligible amount in size. A single female from Peixe Boi, east of Pará, State of Pará, Brazil, (November to December, 1907; H. B. Merrill), in the collection of the Academy, is inseparable from the typical Igarapé-assú series.

#### TETTIGONIIDÆ.

##### Phaneropterinæ.

*Ceraia capra* n. sp. (Pl. II, figs. 36, 37.)

While we have only the female sex of this species its description is justified by the peculiar and unique form of the subgenital plate, and also by the ambisexual characters separating it from the allied species known only from the male. It is apparently nearest to *C. punctulata* and *dentata* Brunner, but from the former it differs in the annulate antennæ, in the lateral lobes of the pronotum being roundly inserted cephalad, in the greater number of spines on the ventral margin of the caudal femora, in the metasternal lobes being rounded instead of trigonal, in the ventral margin of the ovipositor being crenulate but a short distance distad, in the deeply fissate and bicorniform subgenital plate and in the somewhat greater size. From *dentata* the new form can be readily distinguished by the angulate instead of rotundate mesosternal lobes.

Type: ♀; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5310.]

Size moderately large; form well compressed; surface somewhat polished. Head moderately arcuate, weakly elevated dorsad of the general level of the pronotal disk; fastigium subhorizontal, narrow, compressed, particularly proximad, sulcate, the apex faintly bulbous, narrowly in contact with the compressed and slender facial fastigium; eyes but moderately prominent when seen from the dorsum, basal outline subcircular, the depth subequal to that of the infra-ocular portion of the genæ; antennæ broken. Pronotum with the disk deplanate dorsad, greatest caudal width of disk contained one and one-third times in the greatest length of the same; cephalic margin of disk emarginato-truncate, caudal margin strongly arcuate, forming more than the quadrant of a circle; lateral angles of disk rounded, broadly so cephalad, more narrowly so caudad; surface of disk hardly punctulate cephalad, median figure broadly U-shaped, deeply impressed; lateral lobes with their greatest depth distinctly greater than the greatest length, cephalic margin appreciably sinuate, ventro-cephalic angle very broadly arcuato-rotundate, ventral margin broadly rounded subrectangulate, ventro-caudal section

and ventral margin to shortly ventrad of the humeral sinus oblique arcuato-truncate, the infra-humeral section of the margin distinct obtuse-angulate, the humeral sinus rectangulate with the immediate angle rounded. Tegmina surpassing the apices of the caudal femora by about the length of the pronotal disk, in form somewhat elongate, lanceolate, the greatest width contained three and one-third times in the tegminal length; costal margin gently arcuate in distal half, nearly straight in proximal half, sutural margin distad of the anal field straight except for the oblique arcuato-truncate distal fifth, apex rotundato-rectangulate, situated nearer the costal than the main portion of the sutural margin; mediastine vein short, irregular, ramose; humeral and discoidal veins contiguous in proximal two-fifths; median vein diverging slightly proximad of proximal two-fifths of length, bifurcate, the rami reaching the sutural margin; ulnar vein straight except for brief distal arcuation; transverse nervures numerous and regular in discoidal field. Wings surpassing the tegmina in length by a distance nearly equal to the dorsal length of the pronotum, apex moderately acute. Prosternum unspined; mesosternum with the lobes rotundato-acute-angulate; metasternum with the lobes rounded laterad and caudad, hardly any caudo-median production indicated. Abdomen with the disto-dorsal abdominal segment faintly tectate in section, weakly produced mesad, with a distinct but not wide rectangulate emargination, which is bordered laterad by low, rounded, thickened areas of the margin reflexed toward the ventral surface; supra-anal plate reflexed, trigonal; cerci simple, crassate, tapering to delicate apices, gently arcuate; ovipositor slightly more than half again as long as the dorsum of the pronotum, regularly narrowing in depth distad, the proximal half moderately arcuate, distal half straight, the immediate apex obliquely subtruncate, the apex, distal portion of dorsal margin and apex of ventral valves serrulato-denticulate; subgenital plate elongate, compressed, fissate for about one-half its length, the resultant lateral lobes diverging and embracing the base of the ovipositor, each regularly tapering in width to the subaciculate apex. Cephalic and median femora unarmed beneath; cephalic tibiae with four spines on the dorso-caudal margin; median tibiae with five to six spines on the same margin. Caudal femora slightly more than two-thirds as long as the tegmina, robust in proximal half; genicular lobes short bispinose; ventro-external margin of caudal femora with eight short, flattened, sublamellate spines, ventro-internal margin with ten similar spines. Tarsi without arolia.

General color of the body and femora yellow ocher (doubtless changed from green by drying), the caudal section of the pronotum, tegmina (except for yellowish wash proximad) and tibiae warbler green (Ridgway), becoming olive-green distad on the tegmina. Eyes chestnut brown; antennae multiannulate with fuscous (only proximal portion of antennae remaining). Tegmina with a longitudinally disposed series of small fuscous spots between the discoidal and median and ulnar veins, these placed one in each quadrate space and the series weaker proximad, distad not reaching the apex, a few weak scattered similar spots in the ulnar-anal area. Ovipositor with the margins edged with mummy brown; infra-cercal plates fuscous proximad. Cephalic tibiae with foramina fuscous; tibial spines ochraceous, narrowly tipped with black; caudal femora with the vicinity of the bases of the ventral spines auburn.

Length of body (exclusive of ovipositor), 28.6 m.m.; length of pronotum, 7.2; greatest (caudal) width of pronotal disk, 5.8; length of tegmen, 45.5; greatest width of tegmen, 10.4; length of caudal femur, 32.8; length of ovipositor, 11.3.

The type of this species is unique.

*Parableta integricauda* Brunner.

1878. *Parableta integricauda* Brunner, Monogr. der Phaneropt., p. 254, pl. V, fig. 78. [Ecuador; Surinam.]

Igarapé-assú. One male.

So far as we are able to determine from the description of this species the Igarapé-assú specimen belongs here. The eyes, however, are not black but auburn, while the tegmina show but two groups of purplish bordered spots along the ulnar vein. Each of these groups is composed of two distinct spots in contact with each other except for the separation of the vein, the sutural one in each case larger than the other.

The only previous exact records are from Coca (Bolívar) and Valley of Santiago (Giglio-Tos), Ecuador.

*Scaphura sphex* n. sp. (Pl. II, figs. 38-40.)

Allied to *S. nitida*, possessing the same polished surface of the body, tegmina and exposed portions of the wings, the distinctive translucence or even transparency of the tegmina, and form of the same, as well as the characteristic structure of the pronotum. The tegminal corrugations are similar in the two species. From *nitida*, *sphex* differs in the relatively broader tegmina, which are also yellowish hyaline except in the suffused distal fourth, in the wings being hyaline in the same proportion (when at rest) as the tegmina, in the less

thickly plumose proximal section of the antennæ, in the more prominent eyes, in the more slender limbs and in features of the coloration which need not be emphasized on account of color variability in the genus.

Walker's *Aganacris micans*<sup>24</sup> may be related, but the description does not mention the peculiar hyaline character of the tegmina and wings, the former of which is said to be black with a cupreous tinge, the latter blackish.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5303.]

Size medium: form compressed: surface highly polished, the head, ventral portion of the lateral lobes of the pronotum, venter, apex of abdomen and limbs with a greater or lesser amount of whitish pile. Head with the occiput rather strongly inflated, moderately declivent to the fastigium: fastigium but slightly produced, subcompressed, strongly declivent, acuminate when seen from the dorsum, the apex narrowly but strongly rounded, strongly sulcate, ventrad rather broadly in contact with the slightly acute fastigium of the face: median ocellus large; lateral ocelli large, ovate, separated by the fastigium alone: palpi elongate, slender, fifth joint slightly more than half again as long as the third joint: eyes large, prominent, ovate in basal outline, their depth about twice that of the infra-ocular portion of the genæ: antennæ incomplete, proximad moderately plumose. Pronotum short sellate, with the peculiar structural details found in *S. nitida*, when seen from the side the dorsum is strongly concave in cephalic half and deplanate caudad: greatest (caudal) width of the disk equal to about four-fifths the greatest length of the same; cephalic margin of the disk subtruncate, caudal margin strongly arcuate: transverse impression broad, rounded, its center at about cephalic fourth: lateral portions of disk in cephalic half strongly rounded into the lobes, caudad are present distinct angles, which are directed mesocephalad, these passing into the rounded portion; metazona of disk slightly impressed: lateral lobes of the pronotum with the greatest depth one and one-half times in the greatest length of the same; the transverse impression of the dorsum strongly continued on the lateral lobes, caudad of which the surface is somewhat bullate; cephalic margin of the lobes sigmoid, concave dorsad, convex ventrad, ventrocephalic angle rounded obtuse, ventral margin arcuate oblique, ventro-caudal margin very broadly rounded, caudal margin slightly

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<sup>24</sup> Catal. Dermap. Salt. Brit. Mus., V, p. 41, (1871).

oblique, sinuato-truncate, humeral sinus rectangulate. Tegmina surpassing the apices of the caudal femora by somewhat more than the length of the pronotal disk, of the peculiar crinkled character found in *S. nitida*, this being regular proximad in the discoidal field, irregular distad and in the costal field: greatest width of the tegmina at the distal fourth, contained nearly four and three-quarters times in the greatest length; costal margin straight arcuate, briefly arcuate proximad and in the distal fourth; apex well rounded, sutural portion of apex oblique subtruncate; sutural margin concavo-truncate; mediastine vein weak but distinct: humeral and discoidal veins not in contact; median vein diverging from the discoidal vein at the proximal third, bifurcate faintly before its middle; ulnar vein bi- or triramose: stridulating field with the free margin but faintly produced at the apex of the stridulating vein, distad of this gently arcuate; stridulating vein nearly transverse, greatly thickened, subfusiform; speculum greatly elongate, narrow, proximad of the stridulating vein the field is subcoriaceous. Wings projecting distad of the tegmina a distance less than the length of the disk of the pronotum, the apex narrowly rounded. Prosternum elevated in a V-shaped structure, unarmed: mesosternal lobes truncate laterad, rounded rectangulate disto-laterad: metasternal lobes narrow, obliquely arcuate. Disto-dorsal abdominal segment arcuate-emarginate laterad, the distal margin subtruncate mesad, a weak medio-longitudinal impression present: subgenital plate deflexed, trigonal: cerci simple, tapering, arcuate dorsad, the apices very briefly spiniform: subgenital plate narrow, produced, attenuate mesad, projecting almost to the tips of the cerci, the distal margin strongly arcuate-emarginate; styles short, articulate. Limbs slender: cephalic femora subcompressed, moderately deep; cephalic tibiae with the tympana large, reniform: caudal femora nearly two-thirds as long as the tegmina, moderately inflated proximad, very slender distad, ventro-external margin with six to nine, ventro-internal margin with four spines.

General color shining blue black, the pubescence of the body and limbs white, the plumosity of the antennae black. Head with a pair of infra-ocular lines of hazel, the clypeus and labrum marked with the same to ochraceous-buff: palpi incompletely lined dorsad with ochraceous-buff: eyes cinnamon-brown. Pronotum with the ventral portion of the lateral lobes narrowly margined with naples yellow. Tegmina faintly buffy hyaline in the proximal three-fourths, distal fourth strongly washed with blackish fuscous; humeral, discoidal, ulnar and anal veins and rami prominently lined with walnut brown

to blackish fuscous; stridulating field similar in tone to the discoidal three-fourths of the tegmina; stridulating vein broadly black, opaque area proximad of same bright mustard yellow; bordering veins of speculum lined with fuscous, first axillary distad with dragon's-blood red, second with black. Wings with base tint as in tegmina, the veins lined with russet. Metapleura marked dorso-laterad with two points of mustard yellow. Abdomen with two proximal segments with paired dots of mustard yellow on dorsal surface. Coxal region marked more or less strongly with the same color. Venter of abdomen obscurely buffy. Median femora faintly and brokenly lined with mustard yellow on cephalic surface; caudal femora at proximal fourth with sublunate spot on mustard yellow on dorsal face.

Length of body, 16.2 mm.; length of pronotum, 4; greatest width of pronotal disk, 3.2; length of tegmen, 24; greatest width of tegmen, 5.2; length of caudal femur, 15.5.

The type of this striking and remarkable mimetic species is unique. The resemblance of it to certain sphecoid wasps is most extraordinary, and suggested the specific name.

*Stilpnochlora marginella* (Serville).

1839. *Phylloptera marginella* Serville, Hist. Nat. Ins., Orth., p. 405. ["Cape of Good Hope."]

Igarapé-assú. One male.

For comments on this species and close relatives, see a recent summary by the author.<sup>25</sup>

*Anaulacomera nodulosa* Stål.

1873. *A[naulacomera] nodulosa* Stål, Öfvers. K. Vetensk.-Akad. Förhandl., XXX, p. 43. [Surinam.]

Igarapé-assú. January 17 and February 1, 1912 (two specimens). Four males, four females.

These specimens are referred to Stål's species with some uncertainty, as they are all larger than Stål's measurements, although certain individuals are comparable with the dimensions given by Brunner for the species. The species much resembles *A. albonodulosa*, but has the fastigium proportionately shorter and thicker, the pronotum shorter, the cerci briefer and not completely curved and the tegminal venation coarser.

The species has been definitely recorded from Surinam (also Paramaribo) and Chapada, Matto Grosso, Brazil.

*Viadana myrtifolia* (Linnæus).

1758. [*Gryllus* (*Telligonia*)] *myrtifolius* Linnæus, Syst. Nat., X ed., p. 429. [Surinam.]

<sup>25</sup> Entom. News, XXVIII, pp. 107 to 113, (1917).



Igarapé-assú. One female.

A male from Paramaribo, Surinam, (K. Mayo), in the collection of the Academy of Natural Sciences, is specifically identical with the Igarapé-assú female.

The species has been recorded from Surinam, Cayenne and Pará, Brazil.

*Coelophyllum*\* *coriaceum* (Pictet).

1888. [*Protagoga*] *coriacea* Pictet, Mém. Soc. Phys. Hist. Nat. Genève, XXX, No. 6, p. 9, pl. 1, figs. 2, 2a. [Guiana.]

Igarapé-assú. January 17, 1912. One female.

This is, apparently, the first record of the species since the original description.

*Coelophyllum rectinerve* (Brunner).

1891. *Protagoga rectinervis* Brunner, Verh. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 170, 171. [Upper Amazonas.]

Igarapé-assú. One male, one female.

We have before us another female from Chanchamayo, Peru, which fully agrees with the Igarapé-assú individuals. The male is faintly smaller than the original measurements for that sex, but otherwise the specimens are in complete accord with the description.

The range of the species is now known to extend from the upper reaches of the Amazon to its mouth.

#### **Pseudophyllinæ.**

*Acanthedis aquilina* (Linnæus).

1758. [*Gryllus* (*Tettigonia*)] *aquilinus* Linnæus, Syst. Nat., X ed., p. 430. ["Indiis."]

Pará. (C. F. Baker.) One male.

This specimen is inseparable from an individual of the same sex from Cayenne, determined and presented to the Academy by Saussure. The species is known from localities extending from the mouth to the upper portion of the Amazon, north to the Guianas and Venezuela (Meridá).

*Leurophyllum consanguineum* (Serville).

1839. *Acanthodis consanguinea* Serville, Hist. Nat. Ins., Orth., p. 454. [Unknown locality.]

Pará. (C. F. Baker.) One male, one immature male.

This species is known to range from southeastern Brazil north to Cayenne, west to eastern Ecuador.

*Leurophyllum maculipenne* (Serville).

1839. *Platyphyllum maculipenne* Serville, Hist. Nat. Ins., Orth., p. 447. [Brazil.]

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\* See Rehn, Entom. News, XXVIII, p. 152, (1917).

Pará. (C. F. Baker.) One male, one female.

Igarapé-assú. January 29, 1912 (one specimen). Three females.

This striking and beautiful species is well distributed over the Amazonian and Guianan regions.

*Bliastes submarginatus* (Walker).

1870. *Merocidius submarginatus* Walker, Catal. Spec. Derm. Salt. Brit. Mus., III, p. 450. [Pará, Brazil.]

Pará. (C. F. Baker.) One female.

Kirby has placed *Bliastes limbatus* Brunner, described from Pará, as a synonym of *submarginatus*<sup>37</sup>, with which action we fully agree. In the present specimen the caudal genicular lobes of the median femora are spined, and the spines on the ventro-cephalic margin of the cephalic and median femora number three instead of four as described by Brunner.

*Teletias aduncus* Stål.

1874. *T[eleutias] aduncus* Stål, Recens. Orth., II, p. 88. [Unknown locality.]

Pará. (C. F. Baker.) One male.

This specimen fully agrees with the original description and the later one by Brunner. This is the first exact locality known for the species, which was recorded by Brunner from Upper Amazonia.

*Diophanes salvifolium* (Lichtenstein).

"1796. *Locusta salvifolia* Lichtenstein, Catal. Mus. Hamburg, III, p. 82."

Pará. (C. F. Baker.) One female.

This specimen has the wings with a complete but narrow distal and peripheral edging of whitish, while the hyaline character of the interspaces of the axillary and radiate fields of the wings is very pronounced.

#### Copiphorinæ.

*Copiphora cornuta* (DeGeer).

1773. *Locusta cornuta* DeGeer, Mem. Hist. Ins., III, p. 441, pl. 37, fig. 7. (Surinam.)

Pará. (C. F. Baker.) One male.

Igarapé-assú. One female.

These specimens are fully typical of the species, except that the dorso-caudal margin of the median tibiæ bear four to five spines in the Pará individual and five in that from Igarapé-assú. The presence of but three spines on this margin has been considered diagnostic of this species by Karny, but reliance cannot be placed on the number of marginal spines in this instance as in many others, the material before us showing sufficient variation to nullify the

<sup>37</sup> Synon. Catal. Orth., II, p. 331, (1906).

diagnostic value of this feature. We have also before us for study a pair from Paramaribo, Surinam (K. Mayo) and a female from Bartica, British Guiana (March 25, 1913; H. S. Parish), all belonging to the Academy. The five specimens show there is a very decided amount of variation in the intensity of the tuberculation of the fastigium, but all are clearly referable to the same species. Both Guianan females have three spines on the dorso-caudal margin of the median tibiæ, while the Paramaribo male has three spines on this margin on one limb and four on the other.

The species has already been recorded from Pará by Walker and Bruner.

***Acantheremus elegans* Karny.**

1907. *Acantheremus elegans* Karny, Abhandl. k.-k. zool.-botan. Gesell. Wien, IV, heft 3, p. 9, fig. 1. [Surinam.]

Pará. (C. F. Baker.) One female.

This specimen fully agrees with the original description of the species, differing only in the slightly greater size of the specimen before us.

***Neococephalus nigropunctatus* (Redtenbacher).**

1891. *Conocephalus nigropunctatus* Redtenbacher, Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 380, 391, pl. III, fig. 32. [Upper Amazon; Brazil; Surinam; Cuba; Cayenne.]

Pará. (C. F. Baker.) Three males, one female.

Benevides, Pará. (H. H. Smith.) Two males. [U. S. N. M.]

Contamano, Rio Ucayali, Peru. October to December, 1912. One male, two females.

The Contamano specimens have been immersed in a liquid preservative and in consequence all have lost their original coloration, but they are identical with the Pará male, and all fully agree with the original description.

Bruner has recorded<sup>28</sup> the species from Pará and Benevides.

***Neococephalus fratellus* (Griffini).**

1891. *Conocephalus frater* Redtenbacher (not of Kirby, 1890), Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 381, 399. [Cuba; St. Vincent, Lesser Antilles; Trinidad; Brazil; Upper Amazons.]

1899. *Conocephalus fratellus* Griffini, Misc. Entom., VII, p. 5. (New name.)

Pará. (C. F. Baker.) One male.

The tegmina are appreciably shorter in this specimen than the measurements given for those of the same sex by Redtenbacher; otherwise the specimen is typical.

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<sup>28</sup> Ann. Carneg. Mus., IX, p. 392, (1915).

**Homorocoryphus cocanus** (Bolivar).

1881. *Conocephalus cocanus* Bolivar, Anales Soc. Españ. Hist. Nat., X, p. 497. [Coca, Ecuador.]

Pará. (C. F. Baker.) Three males, two females.

Pará. (Thayer Expedition.) One female. [M. C. Z.]

These specimens have been compared with a male from Chanchamayo, Peru, in the collection of the Academy, and found to be inseparable.

The species was recorded from Cayenne by Redtenbacher.

**Homorocoryphus brunneri** (Redtenbacher).

1891. *Conocephalus brunneri* Redtenbacher, Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 385, 423. [Theresopolis, Brazil; Upper Amazons; Buenos Aires and Rosario, Argentina; "Yalapa."]

Igarapé-assú. One female.

**Listroscoelinæ.****Phlugis marginata** (Redtenbacher).

1891. *Thysdrus marginatus* Redtenbacher, Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 534, 537. [Upper Amazonia.]

Pará. (C. F. Baker.) One female.

This specimen, the first known from an exact locality, fully agrees with the original description, except that the caudal femora are slightly shorter.

**Phlugis chelifera** n. sp. (Pl. II, figs. 41-43.)

Closely related to *P. abnormis* (Redtenbacher),<sup>39</sup> from Retalulen,<sup>40</sup> but differing in the somewhat smaller size; in the male cerci being quite short, not a quarter as long as the subgenital plate; in the internal projection of the paired processes of the disto-dorsal abdominal segment of the male being flattened, vertical, decurved plates, instead of spiniform; and in the subgenital plate of the same sex having the expanded distal section proportionately shorter and more sharply expanded, the proximal angle of the dorsal margin of the expansion slightly recurved acute, and in the vertical margin of the same section, when seen from the side, being distinctly indented proximad.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5321.]

Size medium (for the genus): form subcompressed. Head well seated in the pronotum: occiput and interocular space moderately

<sup>39</sup> Verhandl. k.-k. zool.-botan. Gesell. Wien, XLI, pp. 534, 538, pl. IV, fig. 95.

<sup>40</sup> This is apparently an error of transcription for Retahluleu, western Guatemala. Karny was apparently unable to place the locality quoted, and we also have been unable to secure any information concerning it. We feel confident, however, that "Retalulen" is an error for Retahluleu.

declivent cephalad; interspace between the eyes equal in width to one of the eyes, this area supplied with a median impressed point: fastigium of medium width, bilobate and angularly reflexed: face moderately retreating, broadly deplanate: eyes as prominent as usual in the genus, strongly projecting cephalad, when seen from the side the form is ovoid: antennæ surpassing the body in length; proximal joint strongly inflated; second joint moderately inflated. Pronotum of the type usual in the genus, distinctly elongate, metazona well produced, greatest width of the pronotum contained twice in the greatest length of the same: cephalic margin of disk shallowly arcuate-emarginate, caudal margin strongly arcuate; principal sulcus deeply impressed; metazona equal to two-fifths the length of the whole disk; a fine medio-longitudinal impressed line present caudad on the disk; three incomplete transverse sulci indicated on the prozona: lateral lobes two and one-half times as long as their depth, the margin arcuate from the cephalic margin of the disk to the very shallow humeral sinus, faintly flattened ventro-cephalad, caudal margin in general oblique subtruncate from the sinus to the arcuate caudal margin of the disk. Tegmina with length slightly exceeding that of the body, narrow, the greatest width contained over seven times in the length: margins in general straight, subparallel; apex rather narrowly rounded, sutural in position: discoidal vein straight, oblique, joining the costal margin at about its proximal third; number of rami in the marginal field sixteen, these straight and weakly oblique in trend; ulnar vein triramose distad; transverse nervures straight, weakly oblique, in general evenly spaced: tympanal field largely covered by the pronotal extension. Wings surpassing the tegminal apices by half the length of the tegmina, moderately acuminate. Penultimate disto-dorsal abdominal segment large, subcucullate, distal margin broadly arcuate-angulate, the mesal portion of the margin with an overlapping transparent bisinuate lamellation, visible only under fair magnification: disto-dorsal abdominal segment vertical, largely under the penultimate segment, roundly depressed mesad, roundly elevated disto-laterad; free margin with a median very deep U-emargination, laterad of which are paired V-emarginations of subequal depth, the processes between the three emarginations compressed, subfalciform, with their apices subacute and directed ventrad; laterad of the lateral emarginations the segment is produced into subconchate projections, which have a thickened ridge along their dorsal margin and are distinctly concave ventrad, when seen from the side the projections are spatulate, angulato-arcuate

dorsad and distad, narrowly rounded disto-ventrad, sigmoid ventrad: supra-anal plate well hidden, acute-angulate in form: cerci very short, simple, styliform, faintly sinuate, apex blunt: subgenital plate of the elongate, specialized type found in the genus, compressed; when seen from the side the plate is narrowed at the distal third, thence strongly compressed, the dorsal margin arcuate-emarginate with the dorsal angle acute produced; distal margin oblique sinuato-truncate, the disto-ventral angle produced, bluntly angulate, ventral margin angulato-arcuate; when seen from the venter the plate is regularly narrowing distad, the proximal half with a distinct median carina, the distal half narrowly fissate, the apex of the fissure narrowly broadened; when viewed from the dorsum the branches of the plate are seen to be thickened and inflated from the basal excavation of the plate to the disto-dorsal angle, or in the section which is arcuate-emarginate when seen from the side. Cephalic femora with three spines on the ventro-cephalic margin and four on the ventro-caudal margin; cephalic tibiae with five spines on each ventral margin exclusive of the apical ones. Median femora unspined on margins; median tibiae with two spines on the ventro-cephalic margin. Caudal femora of the usual type, with nine very small spines on the ventro-external margin and six of the ventro-internal margin.

General color honey yellow, the wings weakly washed with chamois, parts of the head, lateral lobes of the pronotum and limbs tending toward clay color. Eyes walnut brown.

Length of body, 12.4 mm.; length of pronotum, 3.3; greatest width of pronotum, 1.6; length of tegmen, 12.4; greatest width of tegmen, 1.6; length of caudal femur, 9.1.

In addition to the type we have before us four paratypic males, all from Bartica, British Guiana (H. S. Parish; March 6, 24 and 26; April 15, 1913), in the collection of the Academy. These specimens are all slightly larger than the type, but otherwise inseparable. The number of rami in the costal field of the tegmina ranges from fifteen to eighteen. In these specimens the coloration, particularly of the exposed portion of the wings and distad on the tegmina, is strongly approaching cosse green, the limbs also in part washed with weak javel green.

*Phlugiola redtenbacheri* Karny.

1911. *Phlugiola redtenbacheri* Karny, Abhandl. k.-k. zool.-botan. Gesell. Wien, IV, heft 3, p. 20. [Surinam.]

Branganza, State of Pará. (Miss H. B. Merrill.) One female. [A. N. S. P.]

This specimen fully agrees with the original description and figure. As far as we are aware the two localities given above are all those known for this striking and peculiar genus and species.

**Agroeclinæ.**

***Paralobaspis personata* n. sp.** (Pl. II, figs. 44, 45.)

Differing from *P. picta*,<sup>41</sup> from Ecuador, the genotype and only previously described species of the genus, in the shorter pronotum and shorter and more arcuate ovipositor, the much shorter tegmina, in the coloration of the mouthparts and the face, the latter being solid black in the present species, in the face being almost without impressed punctations, in the generally unicolorous pronotum, in the unicolorous prosternal spines, in the more unicolorous limbs and in the fewer spines on the ventro-cephalic margins of the cephalic and median femora.

Type: ♀; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5322.]

Size medium: form relatively robust, subcompressed: surface smooth. Head with the exposed dorsal length slightly less than one-half as long as the dorsum of the pronotum, ventral portion of head quite broad, narrowing dorsad: fastigium as characteristic of the genus, its plane in general continuous with the occipital line, the apex with a slightly decurved spine, the general direction of which is cephalad, cephalic margin of the fastigium ventrad of the spine distinctly compressed and carinate: paired ocelli subtrigonal in form, median ocellus small, in general circular: face with the very faintest and very sparsest type of punctation: eyes moderately prominent, irregularly subcircular in basal outline, slightly flattened cephalad and even more weakly so ventro-caudad: antennæ over twice as long as the body; proximal joint with the projection on the disto-internal face rounded dentiform. Pronotum with its dorsal line straight when seen from the side, in transverse section moderately arcuate dorsad, rounding broadly into the lateral lobes: disk of pronotum quite narrow on the cephalic half of the pronotum, moderately expanding on the meta-zona, cephalic margin of disk with the faintest possible arcuate emargination, caudal margin of disk regularly arcuate; principal transverse sulcus weakly impressed, placed mesad, prozona crossed at its middle by a more decidedly impressed arcuate sulcus, which is weak mesad: lateral lobes of the pronotum twice as long as deep; cephalic margin of the lobes straight oblique, regularly rounding at the ventro-

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<sup>41</sup> Boll. Mus. Zool. Anat. Comp. Torino, XIII, No. 311, p. 89, (1898).

cephalic angle into the oblique, but more nearly horizontal, weakly sinuate ventral margin, ventro-caudal angle roundly obtuse, caudal margin oblique, in general straight, with a broad though shallow humeral sinus; surface of lateral lobes moderately undulate, having one center of elevation or "boss" on the prozona, the other in the position of similar structures in the *Conocephalinæ*. Tegmina slightly surpassing the apices of the caudal femora, subequal in width, the greatest width contained nearly six times in the length: costal margin straight except for short arcuations proximad and distad, sutural margin straight, apex rounded: principal venation simple; median vein diverging distad of the middle of the discoidal vein; reticulations in general irregular, the transverse nervures clearly defined only in the proximal portions of the marginal and discoidal fields. Wings reaching to the apices of the tegmina. Prosternal spines elongate, aciculate, weakly recurved, parallel: mesosternal lobes narrow, very acute, the apices weakly spiniform: metasternal lobes weakly obtuse-angulate, the angle briefly spiniform. Disto-dorsal abdominal segment with an impressed, medio-longitudinal crease, the free margin being produced each side of this into subspiniform projections, supra-coxal sections of the margin broadly and shallowly arcuato-emarginate: cerdi tapering, with the apices rather sharply aciculate, gently arcuate when seen from the side: ovipositor moderately falcate, in length almost equal to twice the length of the pronotal disk, greatest depth of the ovipositor mesad; dorsal margin of ovipositor very faintly curved in distal two-thirds, ventral margin of same regularly arcuate, apex acute: subgenital plate in general trigonal, the margin having a distinct angulate sinuation each side of the median V-emargination. Cephalic femora subequal to the pronotum in length, the ventro-cephalic margin with two spines distad: median femora with three to four spines in the same position on the same margin; all genicular lobes spined excepting the caudal ones of the cephalic femora. Caudal femora about three-fourths as long as the tegmina, robust proximad, narrowed distad, ventro-external margin with eight spines.

General coloration clay color to ochraceous-buff, the abdomen approaching buckthorn brown, the dorsal aspect of the head and pronotum tinted with the same. Head with a large, solid facial area of moderately shining black, which dorsad involves all of the fastigium excepting its dorsal surface, the proximal antennal joint and the entire face, the black area expanding ventrad from as wide as the space between the ventro-cephalic section of the eyes to wider than that



between the latero-proximal angles of the clypeus, extending caudad as broad lines along the juxta-mandibular portion of the genæ, and as three distinct dorso-ventral bars on the proximal half of the clypeus, one median, the others marginal: mandibles largely zinc orange: eyes dresden brown: antennæ yellow ocher, becoming ochraceous tawny distad, with well-spaced annuli of mummy brown, these more closely placed proximad than distad, the same section of the antennæ with the individual joints marked off by narrow shadow annuli of mummy brown; ventral surface of second article barred transversely proximad and distad with mummy brown. Pronotum with a pair of obliquely disposed spots of mummy brown laterad on the rounded shoulder at the cephalic fifth; pair of similar but very much weaker spots are placed immediately caudad of the transverse sulcus, the four spots having a cruciform disposition; area of the median impression washed faintly with mummy brown. Tegmina with their base color mummy brown, the venation, primary and secondary, forming a meshwork of warm buff to light buff. Wings infumate. Ovipositor sanford's brown. Limbs ochraceous-buff, the femoral spines (marginal) fuscous, with a fuscous spot surrounding the base of each, apices of the caudal femora infusate; external face of the caudal femora with an oblique patterned area of fuscous, consisting of two long lines and portions of a number of generally transverse, briefly arcuate, lines: cephalic tibiæ with a fuscous patch on each face immediately distad of the foramina, the distal extremity also narrowly infusate; median tibiæ with similar areas in similar positions; caudal tibiæ marked with fuscous proximad and distad, all tibial spines tipped with fuscous, those of ventral surface with fuscous surrounding their bases.

Length of body (exclusive of ovipositor), 20 mm.; length of pronotum, 6.3; greatest width of pronotal disk, 3; length of tegmen, 19.8; greatest width of tegmen, 3.2; length of caudal femur, 14.5.

The type of this most interesting species is unique.

#### **Gryllaorinæ.**

*Gryllaoris harpietylata* n. sp. (Pl. II, figs. 46, 47.)

Allied to *G. lævigata* Brunner,<sup>42</sup> but differing in the paired productions of the disto-dorsal abdominal segment being closely placed mesad and spiniform, the whole segment more produced mesad, in the cerci being reduced to brief styliform appendages, in the subgenital plate being large, moderately produced and having greatly

<sup>42</sup> Verhandl. k.-k. zool.-botan. Gesell. Wien, XXXVIII, pp. 321, 344, pl. VIII, fig. 41c. [Upper Amazonia.]

elongate and recurved, hook-like, acute styles, in the smaller general proportions, but actually longer tegmina and wings, in the fewer spines on the ventral margin of the caudal femora, in the restriction of the infuscation of the head to the occiput and fastigium, and in the pronotum being broadly bivittate with fuscous.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5323.]

Size medium: form as usual in the genus, with greatly developed tegmina and wings: surface moderately polished. Head broad, strongly transverse, the face markedly flattened, in fact slightly impressed: occiput strongly arcuate transversely, in side view regularly rounding over the vertex into the face: vertex broad, about one and one-half times as wide as proximal antennal joint, lateral margins subparallel; lateral ocelli ovate, rather small, median ocellus large, elliptical: eyes rather prominent, weakly projecting dorsad, in basal outline elongate-ovoid: antennæ imperfect, at least surpassing the apices of the tegmina and wings, heavy, brittle: third palpal joint moderately arcuate when seen from the side; fourth joint slightly longer than the third joint, straight, tapering proximad in the proximal half, distal half subequal in width, rather narrow; fifth joint slightly longer than the fourth joint, faintly enlarging distad. Pronotum transverse, in general form strongly rounded transversely: cephalic margin of dorsum faintly arcuate produced mesad; caudal margin arcuate laterad, shallowly and broadly arcuate-emarginate mesad; all margins more or less distinctly cingulate: transverse sulci two in number, the cephalic one placed close to the cephalic margin, being intermarginal and deeply impressed on the lateral lobes, the caudal one placed a short distance cephalad of the caudal margin, on the dorsal surface being broadly obtuse-angulate in form, on the lateral lobes carried regularly and straight ventro-cephalad, joining the cephalic transverse sulcus; intervening area, area of humeral shoulders and caudal section of lateral lobes moderately bullate; a medio-longitudinal impressed area is indicated on the middle of the dorsum: lateral lobes of the pronotum subrectangulate in general form, cephalic margin of the lobes straight dorsad, curving through the rounded ventro-cephalic angle into the weakly oblique cephalic two-thirds of the ventral margin, this rounding into the reversed oblique, short caudal third of the same margin, ventro-caudal angle obtuse, caudal margin straight, no humeral sinus present. Tegmina distad becoming coriaceous and pilose, about one and two-thirds times as long as the body, broad, the greatest width at distal fourth and con-

tained but slightly more than three times in the greatest tegminal length; costal margin strongly arcuate in proximal eighth, thence broadly and very shallowly arcuate emarginate to distal third, thence regularly and broadly arcuate to the rounded obtuse-angulate apex; sutural half of distal margin oblique rotundato-truncate, rounding into the sutural margin, which is broadly arcuate, flattened and straight mesad. Wings faintly surpassing the apices of the tegmina, the distal sections as coriaceous and pilose as the tegmina. Prosternum unspined; meso- and metasternal lobes small, rounded laterad. Disto-dorsal abdominal segment large, half domed, dorsal surface with a pair of lateral patches of long pile, a medio-longitudinal impressed cuneiform area placed on the distal half, the free margin mesad supplied with a closely placed pair of slender processes, which when seen from the side are tapering, sinuate, with a recurved apex, these processes reaching as far caudad as the apex of the subgenital plate and their bases placed on each side of the median impression of the segment: cerci simple, tapering, weakly depressed, incomplete in the type, sparse pilose: subgenital plate strongly produced in median linguiform development which is flattened, clothed with long pile and laterad of the base of which spring styles of a most striking type; these being greatly produced, tapering, straight in their distal third, thence regularly arcuate dorsad and mesad, with the apex moderately decurving and produced in a distinct apical spine, the whole of the styles long pilose; the right style is simple, the left is compound, having a dorsal branch forking from the main style near its base, faintly more than one-half as long as the main branch, following the principal arm in attenuation and curve but with an unarmed apex. Cephalic and median femora unarmed beneath; cephalic and median tibiae with three spines distad on each ventral margin. Caudal femora short, robust, weakly tapering distad, ventro-external margin with four to six spines, ventro-internal margin with three large distal and four minute proximal spines; caudal tibiae with three external and four internal spines on the dorsal margin.

General coloration between ochraceous-buff and zinc orange, a broad V-shaped patch dorsad between the eyes and a pair of broad sinuate bars on the pronotum at the usual position of the lateral shoulders and also covering the dorsal half of the lateral lobes, bone brown. Eyes blackish fuscous. Tegmina colorless, semi-transparent proximad on marginal and discoidal fields and translucent washed with pale mummy brown distad; venation pencilled with prout's brown, except immediately at the base of the tegmina, where

it is of the general color; anal field weakly suffused and venation heavily pencilled with bone brown. Wings with the venation weakly pencilled with prout's brown. Disto-dorsal abdominal segment with the paired pilose areas touched with kaiser brown, the paired process of the same segment blackish fuscous; femoral and tibial spines tipped with chestnut brown.

Length of body, 18 mm.; length of pronotum, 3.6; greatest width of pronotum, 4.2; length of tegmen, 29.5; greatest width of tegmen, 9.5; length of caudal femur, 9.6.

The type is unique.

*Gryllacris cruenta* Brunner.

1888. *Gryllacris cruenta* Brunner, Verhandl. k.-k. zool. botan. Gesell. Wien, XXXVIII, pp. 321, 345. [Upper Amazonia.]

Pará. (C. F. Baker.) One female.

This scarce and striking species has been recorded by Griffini, on the basis of a male, from Paramaribo, Surinam.<sup>43</sup> His specimen showed certain differences from the original description, but these he considered to be individual. Our specimen also shows certain differences, but these are only in part those noted by Griffini. Our specimen has the coloration much like that given in the original description, less like that given by Griffini as far as the head and pronotum are concerned. The caudal femora have nine to ten spines on the ventro-internal margin instead of three to four as described, and eight as given by Griffini, while the external margin has seven to eight spines seven are given in the original description and six by Griffini. The caudal tibiae have five spines on each dorsal margin instead of five internal and seven external as originally described, and six external and five to six internal as described by Griffini. It is evident there is considerable variation individually in the number of these spines and their diagnostic value must not be overrated. The present specimen is slightly smaller than the original measurements of the female, except that the ovipositor is of exactly the same length.

#### GRYLLIDÆ.

##### *Gryllotalpinæ.*

*Scapteriscus didactylus* (Latreille).

1804. *Gryllotalpa didactyla* Latreille, Hist. Nat. Gen. Crustac. et Ins., XII, p. 122. [Cayenne; Surinam.]

Paramaribo, Surinam. (K. Mayo.) Two females.

Pará. (C. F. Baker.) One female. (Thayer Expedition.) One female. [M. C. Z.]

Igarapé-assú. January 17 (1) and 23 (1), 1912. Five females.

<sup>43</sup> Ann. Mus. Nat. Hungar., XII, p. 249, (1914).

These specimens all represent the long and narrow headed type of the *didactylus-camerani* group. We have no Brazilian material of this species in the collections before us other than those listed above, and it seems quite probable that some of the older records of this species, particularly those of its occurrence at points far removed from the Guianan region, may relate to *camerani* or other species. We have material and records showing the occurrence of *camerani* over the upper and middle Amazonian regions.

The present series shows great size variation, the extremes in the Igarapé-assú series being very great.

**Rhippteryx circumcincta** Saussure.

1874. *Rhippteryx circumcincta* Saussure, Miss. Scient. Mexiq., Rech. Zool., VI, p. 358. [South America.]

Pará. (C. F. Baker.) One female.

Igarapé-assú. December, 1911 and January 17, 1912 (two specimens with dates). Four males, thirteen females.

This series is quite uniform in coloration and size. The only exact records we have for the occurrence of this species are those of Bruner of material from Benevides and Pará, State of Pará, Brazil.

**Gryllinæ.**

**Hygronemobius albipalpus** (Saussure).

1877. *N[emobius] albipalpus* Saussure, Mélang. Orthopt., II, fasc. V, p. 257. [Rio de Janeiro, Brazil.]

Igarapé-assú. January 17 to 23, 1912. Seven males, fourteen females.

These specimens have been recorded by Hebard in his study of the genus.<sup>44</sup>

**Nemobius brasiliensis** (Walker).<sup>45</sup>

1869. *Argizala brasiliensis* Walker, Catal. Dermapt. Salt. Brit. Mus., I, p. 61. [Brazil; Santarem, Brazil.]

Igarapé-assú. One male.

This widely distributed and striking species has been recorded from as far south as Paraguay and north to Mexico.

**Hemigryllus ortonii** (Scudder).

1869. *Nemobius ortonii* Scudder, Proc. Boston Soc. Nat. Hist., XII, p. 330. [Napó or Marañon (Rivers).]

Pará. (C. F. Baker.) One female.

<sup>44</sup> Entom. News, XXVI, p. 198.

<sup>45</sup> We find that Bruner's *Nemobius argentinus*, recently described from Carcaraña, Argentina (Ann. Carneg. Mus., X, p. 371, (1916)) is identical with the present author's *Nemobius hebarði*, from Buenos Aires and the Misiones, Argentina, described over a year previous (Proc. Acad. Nat. Sci. Phila., 1915, p. 290, figs. 4 and 5, (1915)).

Piexe Boi, east of Pará. November to December, 1907. (H. B. Merrill.) One female.

Igarapé-assú. January 17 and 23, 1912 (two individuals only with dates). Two males, five females.

We have already resurrected and correctly placed this specific name,<sup>46</sup> which antedates Saussure's *kreichbaumeri*, the designation under which this species has been universally reported in the literature. There is some variation in size in individuals of the same sex, but the diagnostic features are always well marked.

*Anurogryllus muticus* (DeGeer).

1773. *Gryllus muticus* DeGeer, Mém. Hist. Ins., III, p. 520, pl. 43, fig. 2. [Surinam.]

Pará. (C. F. Baker.) One female.

Igarapé-assú. Two females.

The Igarapé-assú specimens are quite different in size, but this is not unusual in the species. The Pará individual is appreciably paler than the Igarapé-assú representatives, being more ferruginous and less fuscous. The three specimens examined all have caudate wings.

#### **APHEMOGRYLLUS<sup>47</sup> new genus.**

Related to *Miogryllus* Saussure, differing in the elongate and slender limbs, in the elongate metatarsus of the caudal limbs, in the great reduction in size of the ventral pair of distal spurs of the caudal tibiae, in the striking disposition of the venation of the lateral field of the tegmina in both sexes, in the greater (♂) or lesser (♀) strangulate character of the entire pronotum and in the tegmina of the male sex having no speculum present and the stridulating area very simply developed.

*Generic Description.*—Head broader than the pronotum: inter-antennal portion of face subequal to greatest width of a single antennal scrobe, this area rounded in profile: eyes heptagonoid-ovate in outline, little prominent. Pronotum broader than long, distinctly (♂) or appreciably (♀) strangulate: lateral lobes distinctly longer than deep, the ventral margin obliquely arcuato-truncate. Tegmina of male with dorsal field but weakly developed as a stridulating area, no speculum present; lateral field with two veins in addition to the mediastine vein, these diverging from the base and widely spaced: tegmina of female with venation of lateral field as in male, venation of dorsal field simple. Cephalic tibiae with a decided,

<sup>46</sup> Trans. Amer. Entom. Soc., XLIII, p. 128, (1916).

<sup>47</sup> From *a*, *without*; *ἄφων* voice and *Gryllus*.

large, external foramen and a small internal one of variable exact size and indication. Caudal tibiae with each dorsal margin armed with four to five spines; distal spurs of caudal tibiae three in number on each side, the median the longest in each group, ventral spur on each side short, the two subequal in length: caudal metatarsus elongate, over twice as long as the remaining tarsal joints, dorsal surface armed the whole length of the external margin and distad on the internal margin, internal apical metatarsal spur over one-half as long as third tarsal joint. Ovipositor shorter than caudal femora, straight, apex acuminate, dorsal valves surpassing ventral ones.

*Aphemogryllus gracilis* n. sp. (Pl. II, figs. 48-53.)

Type: ♂; Igarapé-assú, State of Pará, Brazil. February 6, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5327.]

Size small: form much like species of *Nemobius*: surface moderately polished. Head distinctly broader than the pronotum, moderately inflated: occiput strongly and regularly declivent from its caudal section to the interantennal protuberance; latter region but slightly wider than a single antennal scrobe, well rounded when seen from the side, its lateral margins faintly converging ventrad: ocelli disposed in a broad, depressed triangle, relatively large: palpi relatively short, robust, compressed; forth joint of same subequal to the third, slightly expanding; fifth joint distinctly compressed mesad, gradually expanding distad, the apical margin strongly oblique truncate: antennae at least as long as the body. Pronotum strangulate when compared with the head, the greatest width about one and one-half times the greatest length: cephalic margin truncate, caudal margin feebly bisinuate, both margin strongly hirsute, the surface of the pronotum with many short, adpressed hairs; a fine medio-longitudinal sulcus present, which becomes weaker caudad: lateral lobes subquadrate, the ventral margin moderately arcuate ascendent caudad, the ventro-cephalic angle broadly rounded, the ventro-caudal obtuse. Tegmina well developed but falling slightly short of the apex of the body; apex well rounded: lateral field relatively broad; mediastine vein simple, preceded by two free veins, these diverging from an identical point near the base of the tegmen, the space between the vein itself and the first free vein quite wide; humeral and discoidal veins close to one another and at several points coalescing; stridulating field relatively simple, no speculum present and normal Gryllid venation quite recognizable; median vein straight, simple; ulnar

vein short, transverse;<sup>48</sup> anal vein following its general direction as the stridulating vein but not thickened, and from the general neighborhood of the usually present Grylloid anal node continuing an arcuate but longitudinal course to the apical margin of the tegmen; axillary veins three in number, the first terminating at the "node," the second continued, following the trend of the anal vein, to a point of fusion distad on the sutural margin, third axillary vein following the sutural margin distad of the "node:" area between the ulnar and median veins mesad and distad wide, with three cross-veins<sup>49</sup> and distad a spurious longitudinal vein; anal and axillary veins connected by a number of cross-veins. Wings caudate, surpassing the closed tegmina by considerably more than the tegminal length. Cerci very elongate, nearly as long as the body, tapering. Subgenital plate moderately produced, spoon-shaped. Cephalic tibiae with the cephalic face imperforate, but with a smooth elliptical area in the usual tympanal position; caudal face with a large, elongate, elliptico-reniform tympanum. Caudal femora moderately robust, the apex relatively slender: caudal tibiae armed on the dorso-external margin with four spines, the dorso-internal margin with four to five spines; external distal spurs relatively short, the median one slightly more than a third as long as the metatarsus and half again as long as the dorsal one, ventral spur distinctly shorter than the dorsal one, internal distal spurs with the median and dorsal subequal in length, about one-half as long as the metatarsus, the ventral small and subequal to the ventro-external spur: caudal metatarsus slender, moderately compressed distad; dorso-external margin with seven to nine adpressed spines, dorso-external spur faintly more than one-half as long as the internal one, the latter reaching to slightly distad of the middle of the third tarsal joint.

Allotype: ♀; Igarapé-assú, State of Pará, Brazil. January 23, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila.]

The following features are those of difference from the type.

Pronotum faintly less strangulate; cephalic margin of same very shallowly arcuate-emarginate. Tegmina slightly shorter than in the male, reaching not quite to the middle of the abdomen; humeral and discoidal veins well separated, slightly diverging distad, humeral vein not furcate distad: dorsal field with the median, ulnar, anal and two axillary veins regularly disposed, cross-veins indicated

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<sup>48</sup> At least this is the usual position of the ulnar vein in the Gryllinae.

<sup>49</sup> The ulnar vein (so-called) might be considered another one.



sparsely proximad, more frequently distad. Ovipositor straight, robust, shorter than the caudal femora; apex acuminate, ventral valves shorter than the dorsal ones. Caudal femora with four spines on each dorsal margin: caudal metatarsus with five to six spines on the dorso-external margin.

General coloration of the head, pronotum and dorsum of the abdomen ranging from mummy brown (recessive type) to blackish brown—number one of Ridgway (intensive type), the limbs and ventral surface buckthorn brown (recessive type) to mummy brown in those having the darkest dorsal coloration (intensive); tegmina buffy hyaline to weak fuscous hyaline, the venation of the dorsal coloration. Head unicolorous with the mouth-parts washed with ochraceous-tawny to amber brown; ocelli ochraceous-buff to mars yellow; eyes mottled blackish-brown and dresden brown to mummy brown; palpi of the same coloration as the limbs; antennæ of the general coloration. Wings whitish hyaline, with a brownish tinge in the intensive specimens, with a distinct iridescence, longitudinal veins colored similarly to those of the tegmina. Cerci of the dorsal coloration. Pubescence of the limbs golden. Caudal femora washed more or less completely with the dorsal coloration.

*Measurements (in millimeters)*

	Length of body (exclusive of ovi- positor)	Length of pro- notum	Greatest width of prono- tum	Length of teg- men	Greatest width of dorsal field of tegmen	Length of wing distad of tegmen	Length of caudal femur	Length of ovi- positor
♂								
Igarapé-assú, <i>type</i> .....	8.2	1.2	1.6	4.6	1.5	6.3	4.9	....
Igarapé-assú, <i>paratype</i> .....	7.2	1.3	1.8	4.2	1.4	5.8	5	....
♀								
Igarapé-assú, <i>allotype</i> .....	8.8	1.5	2.2	4.5	1.6	7.3	5.2	3.9
Igarapé-assú, <i>paratype</i> .....	9.5	1.7	2.1	4.5	1.6	7.2	5.5	3.9
Rio Pacaya, Peru, <i>paratype</i> .....	8.7	1.9	2.3	4.7	1.6	8.2	5.6	3.5

In addition to the type and allotype we have examined a paratypic series of seven; one male and three females bearing the same date as the type (one female has no date) and three females from Rio Pacaya, Peru, July, 1912, all in the collection of the Academy. When examined for features of variation we find that the paratypic male has five external and four internal dorsal marginal spines on the caudal tibiae. The females all have four spines, excepting one from Igarapé-assú which has four internal on one limb and five on the other. The spines on the dorsal margin of the caudal metatarsus

vary from six to eight in number on the external margin and four to six on the internal margin in the paratypes. The paratype male has the ulnar vein of the tegmina more oblique than in the type and the first cross-vein between the anal and median veins is also more oblique, forming an angle in the anal vein at its juncture, the next cross-vein obliquely sigmoid, while the proximal disposition of the axillary veins of the tegmina is also slightly different. One of the Rio Pacaya females has the humeral vein forked near the base.

***Miogryllus convolutus* (Johannson).**

1763. *Gryllus convolutus* Johannson, Amoen. Acad., VI, p. 399. [Surinam.]

Pará. (C. F. Baker.) Two females.

Igarapé-assú. January 17 to February 6, 1912. Four males, nine females.

These specimens have already been recorded by Hebard in a study of the genus.<sup>50</sup>

***Miogryllus verticalis* (Serville).**

1839. *Gryllus verticalis* Serville, Hist. Nat. Ins., Orth., p. 343. [Cayenne.]

Igarapé-assú. One male.

This macropterous individual has been recorded by Hebard in his study of the genus.<sup>51</sup>

***Miogryllus tucumanensis* Giglio-Tos.**

1894. *G[r]yllus* (*Miogryllus*) *tucumanensis* Giglio-Tos, Boll. Mus. Zool. Anat. Comp. Torino, IX, No. 184, p. 41. [San Pablo, Province of Tucuman, Argentina.]

Igarapé-assú. January 17, 1912 (one). Two females.

These specimens fully agree with the description of this species, except for the presence of caudate wings and having the tegmina slightly longer and overlapping. They are, as far as we can determine, representative of the macropterous condition of this species, a phase previously unknown. In the two specimens the tegmina measure 8.4 and 8.5 millimeters in length, while the other dimensions are as given in the original description.

The reference of the species to *Miogryllus* is according to the original author, and merely tentative as far as we are concerned, for its exact relationship to *Gryllodes* remains to be determined, when more is known of the constancy and variation of characters in the latter genus.

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<sup>50</sup> Journ. N. Y. Entom. Soc., XXIII, p. 109, (1915).

<sup>51</sup> Ibid., p. 121, (1915).

As far as known the species has been taken only at the two widely separated localities given above.

***Gryllus assimilis* (Fabricius).**

1775. [*Acheta*] *assimilis* Fabricius, Syst. Entom., p. 280. [Jamaica.]

Pará. (C. F. Baker.) One male, one female.

Peixe-boi, east of Pará. November to December, 1907.

(H. B. Merrill.) One male, one female.

Igarapé-assú. Two females.

The Pará and Igarapé-assú specimens have been recorded by Rehn and Hebard in a critical study of *Gryllus* as found in America.<sup>52</sup> The Peixe-boi pair would be represented by the following symbols, as previously established by us: ♂, AVauO1; ♀, AVbuO2.

**Oecanthinæ.**

***Lerneca varipes* Walker.**

1869. *Lerneca varipes* Walker, Catal. Spec. Derm. Salt. Brit. Mus., I, p. 72. [Amazon Region.]

Igarapé-assú. One female.

This specimen is inseparable from individuals of both sexes of this species from Caparo, Trinidad, comments on which will be published at a later date.

**Trigonidiinæ.**

***Anaxipha*<sup>53</sup> *esau* n. sp. (Pl. II, figs. 54, 55.)**

Apparently a relative of *A. tibialis* (Saussure), but strongly marked off from any other species, studied or known to us, in the presence of short, curved hairs placed along the veins of the tegmina and also regularly over the intervening areas, the exposed portion of the wings, the body and the limbs being more decidedly haired than usual. From *tibialis* the present species also differs in the shorter and more robust cephalic tibiae, the shorter caudal metatarsi, in the reduction of the cross-veins in the dorsal field of the female tegmina, in the distinct sculpturing of the main veins of the same and in the more robust general form.

Type: ♀; Igarapé-assú, State of Pará, Brazil. February 1, 1912. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5342.]

Size small: form elongate, slender, subcylindrical, wings caudate: surface closely and relatively heavily haired, on the tegmina the hairs

<sup>52</sup> Proc. Acad. Nat. Sci. Phila., 1915, p. 319, (1915).

<sup>53</sup> For comments on the characters separating *Cyrtaxipha* and *Anaxipha*, see Rehn and Hebard, Entom. News, XXIII, pp. 411 and 412; Proc. Acad. Nat. Sci. Phila., 1916, pp. 300 to 302.

are particularly disposed along the longitudinal veins. Head with the greatest width across the eyes subequal to the greatest width at the caudal margin of the pronotum; when seen from the side the interocular section of the head is regularly declivent from the narrowly rounded occiput, interantennal protuberance broadly rounded when seen in the same view, when seen from the dorsum subcompressed; hairs on the rostrum decurved: eyes with axis subvertical, in basal outline broad ovoid, prominent when seen from the dorsum, slightly projecting cephalad: antennæ surpassing the body in length, proximal joint large, moderately deplanate: palpi with the third and fourth joints slender, the third subequal in width; the fourth faintly expanding distad, slightly shorter than the third; fifth joint reversed pyramidal, about one and one-half times as long as the distal margin, which is straight truncate, the joint slightly flattened. Pronotum transverse, its greatest caudal width nearly equal to one and one-half times the greatest length of the same, narrowing cephalad, so that the cephalic width is distinctly less than the caudal width and faintly less than the width of the adjacent portion of the head, in transverse section the pronotum is regularly rounded dorsad and into the lateral lobes; cephalic margin of the dorsum gently arcuate, the caudal margin broadly obtuse-angulate, the immediate angle narrowly rounded, both margins faintly cingulate; hairs on the pronotum large and chætifform, those along the caudal margin directed dorso-caudad, those on the lateral lobes directed cephalad; a short cephalo-median longitudinal sulcus present; lateral lobes longer than deep, rounding into the dorsal surface; ventro-cephalic angle broadly rounded, ventral margin straight, ventro-caudal angle narrowly rounded, caudal margin straight; surface of the lateral lobes obliquely impressed. Tegmina reaching to the apex of the abdomen, pilosity covering the dorsal surface from the region of the humeral angle, the lateral field almost un haired; lateral field with three veins, of which one parallels the margin, another is very brief, the third reaches the costal margin at about the distal fourth of the field; mediastine, humeral, discoidal and median veins of the tegmina subparallel, straight; ulnar vein arcuate proximad; anal vein bent both proximad and distad, straight between, joining the axillary vein at the distal third of the tegmen; axillary veins two in number, these joining and continuing as a single vein. Exposed portion of the wings projecting distad of the closed tegmina a distance slightly greater than one-half the length of the tegmina, haired similar to the tegmina. Ovipositor no longer than the head and pronotum together, robust, dorsal mar-

gin nearly straight, ventral margin arcuate in distal half, apex acuminate: subgenital plate narrowly fissate-emarginate mesad. Cephalic tibiae short, broadly fusiform inflated in proximal two-thirds, subequal and subcompressed in distal third; cephalic face with a large elliptico-reniform tympanum, caudal face with a much smaller elliptical tympanum. Caudal femora subequal in length to the tegmina, moderately inflated; caudal tibiae with three pairs of marginal spurs, which are not opposite in their insertion, the external series slightly more proximal in their position when compared with their equivalent on the internal series, the internal spurs faintly arcuate, their dorso-internal edge also faintly thickened, knife-like and pencilled with blackish; disto-external spurs small; disto-internal spurs very much longer, the dorsal one about two-thirds as long as the metatarsus, the dorso-internal margin thickened and pencilled as on the internal marginal spurs; metatarsi slightly longer than the remaining tarsal joints combined, a single spine present at the disto-internal angle, the internal spur of the metatarsus large, reaching almost to the extremity of the tarsus, slightly falcate, with the dorsal edge thickened and pencilled as is the case with the other internal spurs.

General color ochraceous-buff, the head distinctly and the pronotum faintly washed with weak russet; eyes clear russet; exposed portion of the wings faintly washed with mummy brown, the veins pale; at distal fourth the cephalic and median femora bear narrow, incomplete annuli of weak mummy brown, indications of a similar one are present on the pregeniculate section of the caudal femora.

Length of body, 4.6 mm.; length of pronotum, 1; greatest (caudal) width of pronotum, 1.3; length of tegmen, 3.7; length of exposed portion of wing, 2.7; length of caudal femur, 3.6; length of ovipositor, 1.6.

The type of this species is unique.

***Anaxipha angusticollis* (Saussure).**

1874. *Cyrtoxipha angusticollis* Saussure, Miss. Scient. Mex., Rech. Zool., VI, p. 377, pl. 7, fig. 2. [Eastern Cordillera of Mexico.]

Pará. (C. F. Baker.) One male, one female.

Igarapé-assú. February 1, 1912 (two). Three females.

This striking species, which shows great diversity in form between the sexes, has the coloration more generally punctate, from the present material, than previous descriptions would lead one to suppose. The agreement with the features of the detailed original description is so full there can be no question of the identity, or at the most the very close relationship of the present material. Chopard reported the species from St. Jean du Maroni, French Guiana, and Bruner

refers material from Cacagualito, Colombia; São Luiz de Cáceres, Matto Grosso, Brazil, and British Guiana to it, while Bugaba, Panama is given by Saussure, in the *Biologia*, as another locality. The form of the whole thorax of the male is so remarkable that its isolation from the other members of the genus is quite marked.

*Anaxipha conspersa* (Bruner).

1916. *Cyrtoxipha conspersa* Bruner, Ann. Carneg. Mus., X, p. 406. ["Las Juntas" (250 m.), Department of Santa Cruz, Bolivia.]

Pará. (C. F. Baker.) One male.

We have referred this specimen to *conspersa* although it shows several features of difference, which, however, we feel are due to individual or sexual variation, lack of note or over-emphasis in the original description. In our specimen we see no distinct indication of the ridge, "which separates this region (*i. e.*, depressed section of the vertex) from the front." There is, however, a slight elevation covering the base of the inter-antennal protuberance, which may be the feature referred to by Bruner. The other feature is that the whole occiput caudad of the transverse arcuate depression is solidly mars brown.

*Anaxipha simulaorum* n. sp. (Pl. II, figs. 56-59.)

The slender form, the blackish antennæ and the shape of the cephalic tibiæ and of the ovipositor are quite characteristic of this very distinct species, which has, at a glance, a *Cyrtoxiphine* appearance. The head and palpi, however, are *Anaxiphine* in character.

The species is not closely related to any of the other forms known to us.

Type: ♀; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5340.]

Size very large (for the genus): form moderately elongate, slender, terete: surface of body moderately shining, with numerous hairs, the marginal ones of the pronotum, particularly laterad, elongate and curved. Head in general vertical, its axis slightly retreating ventro-caudad, its greatest longitudinal length slightly less than the greatest depth (including the mandibles); in lateral view the occiput is well arcuate caudad of and between the eyes, thence very strongly arcuate-declivent to the inter-antennal region, which is rounded obtuse-angulate, the ventral section retreating to the clypeal suture; when seen from the dorsum the occiput is broad, very broad behind the eyes, the narrowest portion of the interocular section slightly less than half the width of the head at the caudal margin of the eyes, the least interocular width subequal to the transverse width

of one of the eyes, width of the interantennal protuberance hardly more than one-half that of the interocular space: when seen from the dorsum the eyes are moderately prominent, when seen in lateral view they are sub-reniform ovoid: antennæ with the proximal joint broad, subdepressed, the internal margin roundly enlarged; remainder of antennæ incomplete: palpi slender, elongate, third joint faintly longer than the fifth and distinctly longer than the fourth joint; fifth joint trumpet-shaped, its length about two and one-half times the distal width, distal truncation faintly oblique. Pronotum slightly longitudinal when seen from the dorsum, regularly rounding transversely, when seen from the dorsum slightly expanding caudad; cephalic margin of the dorsum truncate mesad, caudal margin moderately arcuate, these margins cingulate; dorsum with the medio-longitudinal sulcus indicated on the cephalic two-thirds, very deeply so in the median region, a transverse sulcus weakly indicated mesad: lateral lobes longitudinal, with a distinct caudo-ventral trend; cephalic margin and ventro-cephalic angle regularly and broadly rounded, ventro-caudal angle rounded rectangulate, caudal margin slightly oblique, straight, the vicinity of the ventro-caudal angle strongly impressed. Tegmina slightly surpassing the apex of the abdomen, the closed pair cylindrical when seen from the dorsum, the outline of the dorsal field narrowing in the distal fifth; venation simple, prominent, transverse nervures regularly placed, separating areas which are regularly oblong: lateral field with the discoidal vein straight, regularly but weakly diverging from the humeral vein, incomplete veins costad of the mediastine vein two in number. Wings fully developed, caudate, projecting distad of the tegmina a distance slightly greater than the length of the head and pronotum combined. Ovipositor moderately elongate, relatively slender, very faintly arcuate proximad, more strongly so distad; distal extremity moderately acute, weakly crenulate on the dorsal margin, almost to the weak swelling, which is situated at the distal three-fifths: subgenital plate slightly broader than long, the apex briefly fissate, rounding narrowly into the margins of the plate. Cephalic and median limbs elongate, straight, moderately tapering: cephalic femora subequal to the combined length of the head and pronotum; cephalic tibiæ subequal to the femora in length, the distal half quite slender, both faces of the tibiæ with elongate reniform tympana, those of the two faces subequal in size: median femora faintly shorter than the cephalic ones; tibiæ subequal in length to the cephalic tibiæ and distinctly surpassing the median

femora. Caudal femora moderately robust, tapering, surpassing the apex of the ovipositor and falling but slightly short of the tips of the wings; caudal tibiae subequal to the femora in length, very slender, the dorsal margins armed with three pairs of spurs, which are not paired in position, those of the external margins being more proximal in position than the corresponding spur on the internal margin, the spurs slender, slightly falcate or but faintly hooked at the apex, their length about two and one-half times the depth of the tibial shaft; disto-external spurs very short, the median one three times as long as the dorsal and nearly twice as long as the ventral one; disto-internal spurs two in number, elongate, weakly falcate, the dorsal one about one-half as long as the metatarsus and half again as long as the ventral one: caudal metatarsi about one-fourth as long as the tibiae, straight, the dorsal surface with a short recumbent spine on each margin distad, the internal distal spur about one-half again as long as the external one; second tarsal joint elongate cordiform, the third slender.

Allotype: ♂; same data as type. January 26, 1912.

Differing from the description of the type in the following features: Tegmina relatively narrow when seen from the dorsum (the pair in repose), narrowing distad: lateral field of the tegmina relatively broad, subequal in width; mediastine vein diverging regularly from the humeral vein distad, the area between with a number of transverse nervures which divide it into rectangulate spaces; three free veins are present in the proximal section of the lateral field costad of the mediastine vein: humeral vein curving costad at its apex: speculum elongate diamond-shaped, its length about one-half that of the dorsal field of the tegmen, its greatest length slightly more than one-half its length; postaxillary veins three in number; axillary veins two in number. Styles reaching to the apices of the caudate wings.

General color buff-yellow, the pubescence largely golden. In the female there is a medio-longitudinal line of raw umber on the closed tegmina, which is distinct proximad and weakens distad. Eyes fuscous-black; antennæ distad of the proximal joint blackish, the proximal one washed distad with fuscous; second and third tarsal joints of all tarsi washed with fuscous-black; ovipositor rich chestnut brown.

*Measurements (in millimeters).*

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.	Length of ovipositor.
♂ type.....	6.3	1.5	5.3	5.2	2.5
♀ allotype.....	7	1.4	6	5.5	.....

The type and allotype are the only specimens known to us.



**Anaxipha smithi** (Saussure).

1897. *Cyrtoxipha smithi* Saussure, Biol. Cent.-Amer., Orth., I, p. 236.  
[Teapa, Tabasco, Mexico.]

Igarapé-assú. One female.

We have assigned this specimen to *smithi* without having seen Mexican material of either sex, but it agrees with the description, which was based on the male sex, in all features of any importance. Actual comparison may show the Brazilian material to be distinct, but at this time we know of no evidence requiring its separation. The ovipositor is short and robust, much like in *imitator*, but the form of the ovipositor is more robust, with a more decided angle to the dorsal line in *imitator*, while the palpi are more slender and the cephalic tibiae less robust in *smithi*, the coloration also being different.

Chopard<sup>54</sup> has reported this species from four localities in French Guiana.

**Anaxipha aptera** (Chopard).

1912. [*Cyrtoxipha*] *aptera* Chopard, Ann. Soc. Entom. France, LXXXI, p. 410, 4 figs. [Charvein, St. Laurent and Nouveau-Chantier, French Guiana.]

Pará. (C. F. Baker.) One male.

Paramaribo, Dutch Guiana. (K. Mayo.) One male. [A. N. S. P.]

The wingless condition of the known material of this species may not be a specific character of the form, as quite a few species are known to be dimorphic in this respect. The Pará individual has four reddish brown longitudinal lines on the vertex and occiput, the median pair continued on the interantennal protuberance. The Paramaribo specimen has these absent.

**Anaxipha minuta** (Linnaeus).

1767. [*Gryllus*] *minutus* Linnaeus, Syst. Nat., ed. XII, p. 694. ["America" (Surinam according to DeGeer).]

Pará. (C. F. Baker.) One male, one female.

Paramaribo, Dutch Guiana. (K. Mayo.) Three females.

There is so little in the literature to enable us to pin this name down to a definite species, that we are under the necessity of using it for an insect not disagreeing with the insufficient diagnosis, and found in the region from which *minuta* was supposed to have come. The Linnean material is probably not in existence, as Stål did not feel that he had it before him, when preparing the Recensio, although part of the basic material of DeGeer's *testaceus*, which is generally considered synonymous with *minuta*, was in his hands. The present

<sup>54</sup> Ann. Soc. Entom. France, LXXXI, p. 407, (1912).

species shows no features of difference from the Linnean description which might not be due to discoloration of the original material.

**Anaxipha cayennensis** (Saussure).

1897. *Cyrtorhynchus aztecus* var. *cayennensis* Saussure, Biol. Cent.-Amer., Orth., I, p. 235. [Cayenne.]

Igarapé-assú. (H. S. Parish.) Two males.

We have used for comparison material from British Guiana, and found some slight differences, chiefly in the relative width of the dorsal field of the tegmina, but nothing sufficiently marked or constant to make it advisable to separate the two lots. Saussure considered this merely a variety of *azteca*, but we prefer to give the name specific rank until more is known concerning its relationship to *azteca*, in this following Chopard and Bruner. The former author has recorded the species from Nouveau-Chantier, French Guiana; the latter from Santarem, Brazil. Our material is of similar small size to that reported by Bruner.<sup>55</sup>

**Anaxipha nitida** (Chopard).

1912. *Cyrtorhynchus nitida* Chopard, Ann. Soc. Entom. France, LXXXI, p. 408, 4 figs. [Nouveau-Chantier, French Guiana.]

Pará. (C. F. Baker.) One female.

This individual is fully typical of the present striking and beautiful species, although slightly smaller than the original measurements. The antennæ are broadly white annulate on a fuscous ground, at a point about three millimeters from their bases. The coloration of the antennæ is not mentioned in the original description.

**Anaxipha variegata** (Chopard).

1912. *Cyrtorhynchus variegata* Chopard, Ann. Soc. Entom. France, LXXXI, p. 407, 4 figs. [St. Laurent and Nouveau-Chantier, French Guiana.]

Pará. (C. F. Baker.) One male.

This specimen may prove to be distinct from true *variegata*, as it shows certain color features not mentioned by Chopard, but, at present, we prefer to consider these individual variations or the color features to have been omitted from the description by Chopard. The antennæ are solid blackish proximad, then follows a broad cream-colored area, which contains two narrow brown annuli, distad of this the color is pale brownish with regularly placed dark brown annuli. The occiput is pale yellow, caudad broadly blackish brown, like the face and between the eyes, in the middle of the yellow area is a transverse bar of blackish brown. The median femora, like the cephalic ones, have a distal pale area colored like the tibiæ, and in addition a median annulus of the same.

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<sup>55</sup> Ann. Carneg. Mus., X, p. 404, (1916).

**Anaxipha incompta** (Walker).

1869. *Eneoptera incompta* Walker, Catal. Derm. Salt. Brit. Mus., I, p. 67. [Tapayos[Tapajos], Brazil.]

Pará. (C. F. Baker.) One male.

We are identifying this specimen with Walker's species provisionally, or at least until we can ascertain more about the type of the species, as the description is woefully inadequate.

**Anaxipha tibialis** (Saussure).

1897. *Cyrtoxipha tibialis* Saussure, Biol. Cent. Amer., Orth., I, p. 236, pl. XI, fig. 40. [Teapa, Tabasco, Mexico.]

Pará. (C. F. Baker.) Two males, three females.

These specimens show no differences from the description of *tibialis* and we see no alternative but to record them as that species, although comparison with Mexican material is not at present possible. The two male specimens show differences which demonstrate the presence in males of this species of a broad and a narrow type of tegmina, and consequently of the tympanum, also in both sexes of recessive and intensive types of coloration. In the former of these color types the dark lateral bar is quite narrow, distinctly dorsad on the lateral lobes, and on the tegmina pencils but the immediate vicinity of the mediastine vein; in the intensive type the bar is broad and covers all of the lateral lobes except the ventro-cephalic portion, which is yellow, and on the tegmina suffuses a broad belt costad of the mediastine vein.

As we here understand the species it is not far removed from *imitator* (Saussure), from which it differs in the narrower head and pronotum, slightly different shape of the cephalic tibiae and more restricted, less solidly infusate dark areas on the pronotum and tegmina.

**Anaxipha paraensis** n. sp. (Pl. II, figs. 60-62.)

Apparently related to *A. tolteca* (Saussure), described from eastern Mexico, but differing in the broadly rounded lateral shoulders of the pronotum, and in the shorter and narrower tegmina, which have the speculum more longitudinal. Doubtless other features of difference exist which will become apparent on actual comparison of the two forms.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5343.]

Size relatively large, broad, tegmina well vaulted: surface of body well clothed with hairs, which are bristly on the head and pronotum. Head trigonal in cephalic aspect, faintly deeper than broad: occiput moderately declivent to the inter-antennal region, with numerous

bristles which are directed ventro-cephalad; inter-antennal protuberance equal to about one-half the least width of the inter-ocular region: eyes very prominent when seen from the dorsum, their convexity directed cephalo-laterad, when seen from the side their basal outline is reniform-ovoid, the narrower portion ventrad: antennæ reaching at least to the apices of the wings, the proximal joint enlarged but simple: palpi slender, the third and fifth joints subequal in length, the third joint slightly arcuate; fourth joint about two-thirds as long as the third joint; fifth joint trumpet-shaped, the distal margin very faintly oblique-truncate. Pronotum transverse, strongly and regularly narrowing cephalad, the width at the caudal margin about one-third greater than the length of the pronotum, the dorsum broadly and regularly rounding into the lateral lobes; surface of the dorsum and lateral lobes with scattered curved bristles, the margins, but particularly the cephalic, with a regularly placed series of smaller bristles; cephalic margin of the disk faintly arcuate, the caudal margin more distinctly but weakly arcuate; medio-longitudinal impression distinctly but not deeply indicated on the greater portion of the disk, transverse impression distinct, median, arcuate: lateral lobes distinctly longer than deep, subrectangular; cephalic margin oblique, the ventro-cephalic angle rounded obtuse, ventral and caudal margins each straight, the ventro-caudal angle narrowly rounded rectangular, the lobes well indented ventro-caudad. Tegmina broad, distinctly broader than the body, in length slightly surpassing the apex of the body: lateral field broad, subequal in depth; costal margin in greater portion straight, very faint intimation of an emargination mesad, arcuate distad; mediastine vein arcuate proximad and distad, straight for the greater portion of its length, little distant from and subparallel to the humeral vein in the proximal half, the area between these veins crossed by numerous straight transverse nervures; costal section of the marginal field with three incomplete veins, the third of which is a ramus of the mediastine vein: humeral and discoidal veins closely placed, subparallel; median vein parallel to the other veins of the humeral trunk, slightly weaker; stridulating vein regularly arcuate; ulnar vein regularly sigmoid; axillary veins three in number of which the third is strumose; post-axillary veins three in number; speculum roughly diamond-shaped, but slightly longer than broad, the sutural angle the only one of the four which is distinctly rounded, the figure within the speculum complete, ovoid-subcordiform, its area coriaceo-rugulose; apex of the dorsal field of the tegmina slightly acute-angulate. Wings strongly caudate, pro-

jecting distad of the tegmina a distance equal to the length of the tegmina, the exposed portion of the wings faintly fusiform when seen from the side, the dorsal and ventral margins of the same rather thickly hirsute. Styles elongate, slender, tapering, falling but slightly short of the tips of the closed wings: subgenital plate elongate, scoop-shaped, narrowing distad, the distal margin narrowly bisarcuate. Limbs moderately slender, elongate. Cephalic femora moderately tapering; cephalic tibiæ subequal in length to the femora, the proximal five-eighths moderately bullate, the distal three-eighths relatively slender, tympana perforating both faces of the tibiæ, that of the cephalic face relatively large, elongate acute-elliptical, of the caudal face but little more than half that size and ovoid in form. Median tibiæ slightly surpassing the femora in length, but faintly larger in proximal half than in distal half. Caudal femora subequal to the tegmina in length, moderately inflated proximad, tapering thence distad, genicular region very small: caudal tibiæ in length subequal to the femora, three pairs of marginal spurs present, those of the external margin more proximal in position than those of the internal, the spurs nearly straight with the immediate apex briefly hooked; disto-external spurs small, the middle one not more than one-fifth as long as the metatarsus, the dorsal one not more than one-half as long as the middle one, the ventral one about two-thirds as long as the middle one; disto-internal spurs two in number, the dorsal one heavy, tapering, very faintly hooked at the apex, in length slightly more than two-thirds as long as the metatarsus, the ventral spur about three-fifths as long as the dorsal one, more slender: caudal metatarsi slightly less than a fourth as long as the caudal tibiæ, each dorsal margin distad with a single spine, external apical spur about two-thirds as long as the internal one.

General color buckthorn brown, the tegmina dresden brown, the head and thoracic bristles fuscous. The lower face with a weak pattern of liver brown, the interantennal protuberance dorsad with a pair of short, narrow lines of blackish; eyes tawny-olive; antennæ chamois, largely washed on all but the ventral surface with bister. Pronotum, as well as the dorsal surface of the head, with a weak pattern of vandyke brown. Tegmina with the venation lined to a variable degree with bister, those distad on the lateral field with this most evident. Wings with the exposed portion heavily washed with fuscous, the cross veins of the paler general color. Cephalic and median tibiæ weakly marked with fuscous, the tarsi of the same limbs with the same color. Caudal femora with the genicular extremity,

aside from the arches, marked with fuscous, the dorsal surface of the caudal tibiæ and the marginal spurs weakly washed with the same shade.

Length of body, 7 mm.; length of pronotum, 1.4 mm.; greatest width of pronotum (caudad) 2 mm.; length of tegmen, 6 mm.; greatest width of dorsum of tegmen, 2.5 mm.; length of wings distad of tegmen, 4.6 mm.; length of caudal femur, 5.8.

The type of this species is unique.

*Anaxipha fistulator* n. sp. (Pl. II, figs. 63-66.)

Allied to *A. championi* (Saussure), from Panama, but differing in the more elongate palpi, the distal joint of which is markedly elongate and obliquely truncate distad, in the more sharply inflated and then narrowed cephalic tibiæ, the differently shaped lateral lobes of the pronotum and in the more slender caudal femora. When compared with *A. stramenticia*, described below, *fistulator* is seen to be quite close, but the latter differs in its distinctly larger size, somewhat differently shaped palpi and cephalic tibiæ and has the pronotum more strongly transverse.

Type: ♂; Igarapé-assú, State of Pará, Brazil. (H. S. Parish.) [Acad. Nat. Sci. Phila., Type no. 5341.]

Size quite large (for the genus): form subdepressed, the tegmina broader than the body, wings long caudate: surface of the body rather thickly covered with hairs, many of those of the head and pronotum chætiform. Head broad sub-cordiform in outline when seen from the cephalic aspect, the greatest width across the eyes but faintly less than the length, the buccal region quite narrow, the occipital outline arcuate transversely; in lateral aspect the dorsum of the head is seen to be strongly, but uniformly declivent to the inter-antennal protuberance, which broadly rounds caudad to the clypeal suture: eyes moderately exerted and well rounded when seen from the dorsum, in basal outline short and broad ovate: antennæ incomplete, the proximal joint broad: palpi slender, elongate; third joint gently arcuate, faintly shorter than the fifth joint; fourth joint about three-fifths as long as the fifth joint, the latter trumpet-shaped, the distal margin obliquely truncate. Pronotum weakly sellate, strongly narrowing cephalad, the pronotum distinctly transverse, the greatest caudal width more than twice that of the cephalic margin of the disk and equal to one and one-half times the length of the pronotal disk, the dorsum broadly rounding into the lateral lobes: cephalic margin of the disk subtruncate, rounding into that of the lateral lobes; caudal margin of the disk truncate; medio-longitudinal sulcus indicated

over the greater portion of the length of the disk, not reaching either margin, more distinctly indicated cephalad: lateral lobes subquadrate, ventral margin truncate, cephalic margin oblique, sub-truncate, ventro-cephalic angle rounded obtuse, caudal margin straight, ventro-caudal angle broadly rounded rectangulate; impression of lateral lobes moderately indicated, oblique, appreciably in bent ventro-caudad. Tegmina relatively broad, the greatest width of the disk contained about two and one-half times in the length of the same, when in repose the greatest width across the dorsal fields of the tegmina is at three-fifths the length of the tegmina, the margin of the extremity of the field weakly acute-angulate: lateral field moderately broad, subequal in width; mediastine vein moderately but regularly diverging from the humeral vein in proximal half, thence subparallel or weakly converging distad; two free veins present cephalad of the proximal half of the mediastine vein: humeral vein prominent and straight for the greater portion of its length, sharply decurved at its apex; discoidal vein in general paralleling the humeral vein, obtuse-angulate at the distal four-fifths; stridulating vein strongly but not regularly arcuate; axillary veins two in number, post-axillary veins three in number; ulnar vein strongly arcuate in proximal three-fourths; speculum oblique sub-rectangulate, the proximal angle and the distal angle rectangulate, the costal angle weakly obtuse, the sutural angle rounded, the greatest (transverse) width of the speculum subequal to the length, figure of the speculum complete, following the costal outline less distinctly than the others. Wings with the caudate section but slightly shorter than the tegmina, well haired along the dorsal and ventral margins. Subgenital plate relatively small, narrowing distad, the distal margin rather sharply and deeply bisarcuate: styles slightly surpassing the apices of the caudal femora, tapering, robust proximad. Cephalic femora moderately robust, tapering, in length subequal to the head and pronotum combined; cephalic tibiae subequal to the femora in length, the proximal five-eighths distinctly inflated, the distal section relatively slender, tympanum of the cephalic face large, elongate subelliptical, of the caudal face distinctly smaller, sub-elliptical. Median limbs missing. Caudal femora faintly longer than the tegmina, moderately robust proximad, regularly tapering, very slender distad; caudal tibiae subequal to the femora in length, slender, the marginal spurs of the same number and disposition as in the other new species of the genus here described; disto-external spurs small, the dorsal one very small, hardly more than a third the length of the median one, the ventral spur

faintly more than half the length of the median one; disto-internal spurs two in number, the dorsal one five-eighths of the length of the metatarsus, the ventral one two-thirds the length of the dorsal one: caudal metatarsi contained about four and one-half times in the length of the tibiae, the dorsal surface armed distad with a pair of spines, distal spur of the external side two-thirds as long as the internal one.

General color straw yellow, the tegmina more clear yellow ochre, the head with an indefinite tawny wash, the caudate portion of the wings, when closed, washed with weak buckthorn brown. Eyes cinnamon brown.

Length of body, 7.9 mm.; length of pronotum, 1.2; greatest caudal width of pronotum, 1.9; length of tegmen, 6; greatest width of dorsum of tegmen, 2.5; length of exposed caudate section of wing, 5; length of caudal femur, 6.

The type of this species is unique.

*Anaxipha stramenticia* n. sp. (Pl. II, figs. 67-70.)

This species is apparently more closely related to *granadensis* (Rehn), from Nicaragua, *championi* (Saussure), from Panama, and *fistulator*, described above, than to the other species known to us. From *granadensis* it differs chiefly in the different profile of the head, this having the occiput and fastigium very much less deplanate declivent, in the distal palpal joint being very strongly oblique truncate distad, in the more quadrate lateral lobes of the pronotum, in the dorso-internal spur of the caudal tibiae being half as long as the metatarsus, and the caudal metatarsal internal spur distinctly surpassing the second tarsal joint, in the sparser tegminal venation of the female (the only sex known of *granadensis*) and in the exact shape of the apex of the ovipositor. From *championi* the new form differs chiefly in the obliquely truncate distal margin of the distal palpal joint and the more decidedly slender distal portion of the cephalic femora, while from *fistulator* it is distinguished chiefly by its smaller size, more sharply narrowed cephalic tibiae, less strongly transverse pronotum and less attenuate caudal femora.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5345.]

Size medium (for the genus): form relatively elongate, the wings caudate: body and limbs thickly clothed with short hairs, on the head and pronotum many are more elongate and chaetiform. Head broad cordiform when seen from the cephalic aspect, the greatest width across the eyes not exceeded by the depth of the head, the occipital line moderately arcuate when seen from the front; in lateral



aspect the dorsal line of the head is moderately declivent from the occiput to the inter-antennal protuberance, which broadly rounds over the ventral section of the facial line to the clypeal sulcus; width of inter-antennal protuberance not quite equal to one-half the least width between the eyes: eyes when seen from the dorsum quite prominent, full, in basal outline broad ovoid, flattened caudad: palpi slender, elongate; third joint in length subequal to the fifth joint, moderately arcuate; fourth joint about three-fifths of the length of the third joint; fifth joint trumpet-shaped, flaring quite markedly, the distal margin rather strongly oblique truncate: antennæ incomplete, the proximal joint broad, distinctly depressed. Pronotum rather small, sub-selliform, weakly enlarging caudad, the dorsum rather broadly rounding into the lateral lobes; cephalic margin of the disk sinuato-truncate, caudal margin arcuato-truncate, medio-longitudinal sulcus distinctly indicated mesad and very briefly cephalad, transverse impression weakly indicated, bisarcuate: lateral lobes subquadrate in form, the margins straight, the angles well rounded; ventro-caudal section moderately but not strongly in-bent. Tegmina but little broader than the body, in length but faintly surpassing the apex of the abdomen: lateral field broad, subequal; mediastine vein regularly diverging from the humeral vein, the area between with weakly indicated transverse nervures, which divide the area into subquadrate areolets; accessory veins of the lateral field three in number, situated costad of the mediastine vein, one simulating and subparalleling the mediastine vein, the other two (which are costad) short and sinuate: humeral and discoidal veins straight in general, subparallel: dorsal field with the greatest width at five-eighths the length from the base, distal margin of the discoidal field rounded obtuse-angulate; stridulating vein bent arcuate; axillary veins two in number (not counting the thickened marginal node); postaxillary veins three in number; ulnar vein moderately sigmoid, more so proximad than distad; speculum oblique subrectangulate, the greatest width of the same (between angles) equal to about three-fourths of the length, proximal angle weakly acute, distal angle rectangulate, costal angle rounded obtuse, sutural angle rather broadly rounded, figure of the speculum complete, unsymmetrical elongate subelliptical. Wings with the caudate portion projecting distad of the tegmina a distance equal to three-fourths of the length of the tegmina. Subgenital plate short, slightly transverse, scoop-shaped, the lateral margins converging distad, the distal extremity with a relatively deep emargination, which is made weakly bisarcuate by a median

triangular projection: styles nearly reaching the tips of the caudate wings. Cephalic femora subequal to the length of the head and pronotum combined, straight, tapering; cephalic tibiae faintly shorter than the femora, strongly inflated in the proximal half, subequal and moderately slender distad, tympanum of the cephalic face large, elongate elliptical, of the caudal face smaller, subelliptical. Caudal femora faintly shorter than the tegmina, moderately robust proximad, tapering distad: caudal tibiae subequal to the femora in length, the marginal spines placed as in the other species here described, disto-external spurs very small, the dorsal one minute, disto-internal spurs two in number, the dorsal one half as long as the metatarsus, the ventral one two-thirds as long as the dorsal one: caudal metatarsi with its length contained about three and one-half times in the length of the caudal tibiae, the dorsal margins each armed distad with a single tooth, distal spur of the internal face reaching to about the middle of the third tarsal joint, the external spur hardly surpassing the middle of the second joint.

Allotype: ♀; same date as the type.

Differing from the description of the type in the following features. Pronotum relatively heavier than in the male, broader in proportion to the width of the head, the caudal margin of the disk weakly produced mesad, rounded, very faintly sinuate laterad of the median production: lateral lobes with the cephalic margin more oblique truncate, the ventro-cephalic angle rounded obtuse. Tegmina narrow, elongate, slightly surpassing the apex of the abdomen (exclusive of the ovipositor), when in repose the lateral margins of the tegmina are subparallel, narrowing at the distal extremity to the narrowly rounded apex: lateral field with the veins more regularly disposed than in the male, straighter, and more distinctly diverging: dorsal field with the anal and axillary (two) veins moderately sinuate, transverse nervures numerous and irregularly distributed. Ovipositor in length subequal to that of the head and pronotum combined, moderately falcate, of medium depth, distal extremity of the dorsal margin and the vicinity of the valvular suture in the distal third with fine strumose denticulations, apex acute.

General color antimony yellow, becoming warm buff on the tegmina, the abdomen with a tendency toward ochraceous-buff, ovipositor tipped with mars brown, the eyes varying from the general color to dresden brown.

*Measurements (in millimeters).*

	Length of body.	Length of pronotum.	Greatest width of pronotum.	Length of tegmen.	Length of wings distad of closed tegmina.	Length of caudal femur.	Length of ovipositor.
♂, type.....	6.2	1.1	1.9	5.2	4.4	5.5	....
♀, allotype.....	6	1.3	1.8	5	4	5.5	2.3

In addition to the type and allotype we have before us a paratypic pair, bearing the same data as the type. These specimens show no differences worthy of remark.

**Eneopterinae.*****Aphonomorphus major* Chopard.**

1912. *A[phonomorphus] major* Chopard, Ann. Soc. Entom. France, LXXXI, p. 429, 3 figs. [St. Laurent du Maroni, French Guiana.]

Igarapé-assú. One female.

This specimen is somewhat damaged and the form of the distal palpal joint is not satisfactorily ascertainable, but in all other important ambisexual features our specimen agrees with the description of *major*, which was based on the male. The dorso-internal margin of the caudal tibiae has one more spine (six instead of five) than Chopard gives, but this is probably a purely individual feature.

***Aphonomorphus griseus* Chopard.**

1912. *A[phonomorphus] griseus* Chopard, Ann. Soc. Entom. France, LXXXI, p. 430, 2 figs. [La Forestière, French Guiana.]

Igarapé-assú. January 17, 1912. One male.

We are assigning this specimen here although it shows at least one point of difference from Chopard's description. This is in the presence of but two, instead of three, spines on the dorso-external margin of the caudal metatarsi. Our specimen has the body length slightly greater than Chopard's measurement, and the distal palpal joint seems rather elongate to answer the original "aussi long que large." However, the features of agreement are so pronounced and the features of difference those of possible individual variation, or of exact interpretation of the proportions of a relatively difficult shape to describe, that we consider our present course of reference best.

***Aphonomorphus surdus* n. sp. (Pl. II, figs. 71-74.)**

Apparently allied to *A. variegatus* and *griseus* Chopard, from Cayenne, and *A. conspersus* Bruner, from Bolivia. From *variegatus* it differs chiefly in the different spination of the caudal tibiae, in the different coloration, in the more elongate limbs, in the smaller ocelli, in the greater general size, in the deeply sulcate subgenital plate of the male, and in the fewer mediastine rami of the tegmina. From *griseus* it differs in the greater general size, in the smaller ocelli, in the lateral lobes of the pronotum being longer and shallower in propor-

tion, in the pronotum being less narrowed cephalad, in the more elongate limbs, in the deeply sulcate subgenital plate of the male and in the different coloration. From *conspersus* the new form differs in the smaller, non-attinent ocelli, the more fusiform cephalic tibiae, the generally less robust limbs, the more elongate caudal metatarsal spurs, and the less strongly divided subgenital plate of the male and in certain features of the coloration. Comparison can hardly be made with *lividus* (Burmeister), as its diagnosis is so brief and indefinite that the recognition of the species without the re-examination of the type would be purely guess-work.

Type: ♂; Pará, State of Pará, Brazil. (C. F. Baker.) [Acad. Nat. Sci. Phila., Type no. 5363].

Size medium: form elongate, quite slender, subcompressed surface of body and limbs rather thickly pilose, this generally adpressed; of tegmina microscopically adpressed pilose. Head no wider than the cephalic section of the pronotum, depth of the head subequal to the width across the eyes: occiput gently declivent cephalad, the fastigium plane and non-excavate; when seen in lateral outline the interantennal angle is rounded obtuse-angulate: ocelli of medium size, placed in an arcuate line, the median one rather small, elliptical, transverse, separated from the lateral ocelli by faintly more than the length of the median ocellus, fossetted; lateral ocelli large, sub-circular, flattened, placed longitudinal, separated from the eyes by less than their own diameter: rostrum with the interantennal width faintly greater than the width of the proximal antennal segment, briefly fossulate dorsad: eyes moderately prominent, in basal outline broad subpyriform: palpi moderately elongate; third joint long; the fourth somewhat shorter, narrow at its base; fifth joint as long as the fourth joint, produced securiform, the distal width slightly less than the length of the joint, flexor margin nearly straight with a distal rounding to the arcuato-truncate distal margin, extensor margin gently concave: antennae elongate; proximal joint moderately depressed, narrowed proximad. Pronotum transverse, the greatest median length contained one and one-half times in the greatest caudal width of the same; in transverse section arcuate, rather broadly rounding into the lateral lobes: cephalic margin subtruncate; caudal margin strongly bisinuate, decidedly produced arcuate mesad; lateral borders of disk moderately diverging caudad; cephalic and caudal margins cingulate, the former with this moderately, the latter extremely, broad; pyriform impressions of the disk large, broad; lateral lobes of the pronotum one and one-half times as

long as deep, somewhat impressed ventrad; ventro-cephalic angle broadly rounded, ventral margin arcuate, ventro-caudal angle rounded obtuse and broadly lamellato-cingulate, the other margins rather narrowly cingulate. Tegmina surpassing the tips of the caudal femora by about the length of the pronotum; when seen from the dorsum the lateral borders of the dorsal fields of the tegmina regularly converged distad: lateral field of uniform depth in the proximal third, thence regularly narrowing distad; mediastine vein with five rami; lateral field with five proximal free veins; hyaline intercalated field very elongate, reaching to the proximal third of the lateral field: dorsal field rather narrow, five times as long as greatest breadth, regularly narrowing in distal half; between the median and the short anal vein there is but a brief section of the ulnar vein which is distinctly traceable, all the other longitudinal nervures irregular and sinuate, the cross-veins irregularly distributed and oblique sectors not clearly defined; anal and the two axillary veins oblique, straight, regularly disposed, connected by numerous cross-veins. Wings surpassing the tegmina by slightly more than the length of the pronotum. Cerci very slender, elongate, reaching almost to the tips of the wings, clothed with numerous, rather adpressed, short hairs and sparse, erect, long hairs, decurved: subgenital plate elongate scaphiform, subcompressed, with a deep medio-longitudinal sulcus on the ventral surface; distal margin U-emarginate. Limbs moderately slender, third joint of tarsi slender. Cephalic tibiae with an elongate elliptical foramen on the cephalic face, caudal face imperforate. Caudal femora moderately slender, about two-thirds as long as the tegmina: caudal tibiae very faintly shorter than the caudal femora; dorsal surface armed distad as follows: on external margin with five major spines, on internal margin with six, those of the internal slightly longer than those of the external; the intercalated spinulations placed, on external margin—3 (or 4), 4, 2, 1; on internal margin—1, 2 (or 3), 2, 1, 0; dorso-internal distal spur over twice as long as the ventral, almost as long as the metatarsus; external distal spurs short: caudal metatarsi armed on the dorso-external margin with a single (distal) spinulation, on the dorso-internal margin with three spinulations, metatarsal spurs very long, the internal slightly longer than the external, faintly arcuate when seen from the side, arcuate proximad when seen from the dorsum.

Allotype: ♀; same data as type. [Acad. Nat. Sci. Phila.]

Differing from the description of the male (type) in the following

features. Size larger: form and vestiture similar. Head slightly deeper than width across the eyes: ocelli similar to those of the male but slightly smaller. Pronotum with cephalic margin distinctly arcuato-emarginate; lateral borders of disk less distinctly diverging caudad than in the male. Tegmina surpassing the tips of the caudal femora: mediastine vein with eight rami; lateral field with five free veins proximad: dorsal field with its width contained slightly more than five times in the tegminal length. Cerci very elongate, appreciably surpassing the tips of the wings: subgenital plate of the type usual in the female sex of the genus, moderately compressed: ovipositor in length surpassing that of the caudal femora by not more than one-half the dorsal length of the pronotum, slender, compressed, moderately decurved in proximal half, thence straight; apical valves acute lanceolate, ventro-external surface of valves shagreenous, the ventral surface crassly crenate-dentate, the productions unequal and irregular in size, these arranged in several series. Caudal tibiae with the intercalated spinulations numbering 3 (or 5), 3, 2, 1 (or 2) on the external margin; 2, 3 (or 4), 1, 1, 0 on the internal margin.

General coloration of the male buckthorn brown, of the female between cinnamon-brown and dresden brown, in both sexes with an overlying coloration of points of mummy brown and blackish fuscous; pubescence pale golden. Head with the ocelli bordered dorsad by a transverse, poorly defined band of fuscous; ocelli Naples yellow; eyes hazel, obliquely and rather irregularly barred dorsad with three lines of fuscous; antennae multiannulate with mummy brown on an ochraceous-buff ground, the contrast decided in the male, hardly apparent in the female. Pronotum with the cephalic and caudal margins beaded with fuscous except in the male, where the caudal margin is unmarked dorsad. Tegmina with the median vein strongly, closely and quite regularly beaded with blackish fuscous, except in proximal fifth, spot at base of humeral trunk blackish fuscous; dorsal surface with five oblique clouds of fuscous in the female, the cross-veins largely lined with fuscous, in the male no clouds are indicated and but a few cross-veins are pencilled; lateral field of female with cross-veins pencilled with fuscous; longitudinal veins all lined with dull ochraceous-tawny; intercalated field washed with mummy brown in the male, nearly clear hyaline in the female. Limbs thickly and closely speckled with fuscous in the female, in the male this hardly indicated on the caudal limbs, and much less distinctly so on the others than in the female; caudal

femora with the ventral margin broadly beaded with fuscous distad; caudal tibiae with the spines and spurs annulate mesad with fuscous. Ovipositor with the tips fuscous.

♂ (type). Length of body, 19.5 mm.; length of pronotum, 3; greatest (caudal) width of pronotum, 4.4; length of tegmen, 19; greatest width of dorsal field of tegmen, 3.9; length of caudal femur, 12.8.

♀ (allotype). Length of body, 18 mm.; length of pronotum, 3.6; greatest (caudal) width of pronotum, 5; length of tegmen, 22.2; greatest width of dorsal field of tegmen, 4.4; length of caudal femur, 15; length of ovipositor, 16.

The type and allotype are the only individuals of the species seen by us. It is evident that the male is in a recessive type of coloration, the female in an intensive one.

#### EXPLANATION OF PLATES I AND II.

##### PLATE I.

- Fig. 1.—*Ischnoptera crispula* new species. Wing of male (type). (×6.)  
 Fig. 2.—*Ischnoptera crispula* new species. Pronotum of male (type). Dorsal view. (×6.)  
 Fig. 3.—*Ischnoptera crispula* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)  
 Fig. 4.—*Ischnoptera crispula* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)  
 Fig. 5.—*Ischnoptera imparata* new species. Wing of male (type). (×8.)  
 Fig. 6.—*Ischnoptera imparata* new species. Pronotum of male (type). Dorsal view. (×6.)  
 Fig. 7.—*Ischnoptera imparata* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)  
 Fig. 8.—*Ischnoptera imparata* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)  
 Fig. 9.—*Ischnoptera clavator* new species. Wing of male (type). (×4.)  
 Fig. 10.—*Ischnoptera clavator* new species. Pronotum of male (type). Dorsal view. (×6.)  
 Fig. 11.—*Ischnoptera clavator* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)  
 Fig. 12.—*Ischnoptera clavator* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)  
 Fig. 13.—*Ischnoptera castanea* Saussure. Genital orifice of male. Igarapé-assú, Brazil. Caudal elevation. (Greatly enlarged.)  
 Fig. 14.—*Ischnoptera castanea* Saussure. Subgenital plate of male. Igarapé-assú, Brazil. Ventral view. (Greatly enlarged.)  
 Fig. 15.—*Cariblatta igarapensis* new species. Pronotum of male (type). Dorsal view. (×6.)  
 Fig. 16.—*Cariblatta igarapensis* new species. Genital orifice of male (type). Caudal elevation. (Greatly enlarged.)  
 Fig. 17.—*Cariblatta igarapensis* new species. Wing of male (type). (×5.)  
 Fig. 18.—*Cariblatta igarapensis* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)  
 Fig. 19.—*Chorisonaura parishi* new species. Pronotum of male (type). Dorsal view. (×7.)  
 Fig. 20.—*Chorisonaura parishi* new species. Tegmen and wing of male (type). (×7.)

- Fig. 21.—*Chorisonera parishi* new species. Subgenital plate of male (type). (Greatly enlarged.)
- Fig. 22.—*Melestora minutissima* new species. Dorsal view of male (type). (×7.)
- Fig. 23.—*Melestora minutissima* new species. Apex of abdomen of male (type). Ventral view. (Greatly enlarged.)
- Fig. 24.—*Tetralania surinama* (Linn.). Median femur of male. Pará, Brazil. (Greatly enlarged.)
- Fig. 25.—*Tetralania phila* new species. Median femur of male (type). (Greatly enlarged.)
- Fig. 26.—*Tetralania surinama* (Linn.). Caudal femur of male. Pará, Brazil. (×3.)
- Fig. 27.—*Tetralania phila* new species. Caudal femur of male (type). (×3.)
- Fig. 28.—*Chloropseustes leucotylus* new genus and species. Lateral view of male (type). (×2½.)
- Fig. 29.—*Chloropseustes leucotylus* new genus and species. Pronotum of male (type). Dorsal view. (×7.)
- Fig. 30.—*Chloropseustes leucotylus* new genus and species. Apex of abdomen of male (type). Lateral elevation. (×7.)
- Fig. 31.—*Chloropseustes leucotylus* new genus and species. Apex of abdomen of female (allotype). Lateral elevation. (×7.)
- Fig. 32.—*Bucephalacris falcifer* new species. Apex of abdomen of male (type). Dorsal view. (×7.)
- Fig. 33.—*Bucephalacris falcifer* new species. Apex of abdomen of male (type). Lateral elevation. (×7.)
- Fig. 34.—*Sitalces jugatus* new species. Apex of abdomen of male (type). Lateral elevation. (×6.)
- Fig. 35.—*Sitalces jugatus* new species. Apex of abdomen of male (type). Dorsal view. (×6.)

## PLATE II.

- Fig. 36.—*Ceraia capra* new species. Meso- and metasternal lobes of female (type). (×3.)
- Fig. 37.—*Ceraia capra* new species. Ovipositor and subgenital plate of female (type). (×2.)
- Fig. 38.—*Scaphura sphex* new species. Lateral view of tegmen of male (type). (×1½.)
- Fig. 39.—*Scaphura sphex* new species. Head of male (type). Dorsal outline. (×5½.)
- Fig. 40.—*Scaphura sphex* new species. Pronotum of male (type). Lateral elevation. (×3.)
- Fig. 41.—*Phlugis chelifera* new species. Apex of abdomen of male (type).<sup>44</sup> Dorsal view. (Greatly enlarged.)
- Fig. 42.—*Phlugis chelifera* new species. Apex of abdomen of male (type).<sup>44</sup> Ventral view. (Greatly enlarged.)
- Fig. 43.—*Phlugis chelifera* new species. Apex of abdomen of male (type).<sup>44</sup> Lateral elevation. (Greatly enlarged.)
- Fig. 44.—*Paralobaspis personata* new species. Pronotum of female (type). Lateral elevation. (×3.)
- Fig. 45.—*Paralobaspis personata* new species. Ovipositor of female (type). (×4.)
- Fig. 46.—*Gryllacris harpistylata* new species. Apex of abdomen of male (type). Dorsal view. (Greatly enlarged.)
- Fig. 47.—*Gryllacris harpistylata* new species. Apex of abdomen of male (type). Lateral elevation. (Greatly enlarged.)
- Fig. 48.—*Aphemogryllus gracilis* new genus and species. Tegmen of male (type). Dorsal field. (×8.)
- Fig. 49.—*Aphemogryllus gracilis* new genus and species. Tegmen of male (type). Lateral field. (×8.)

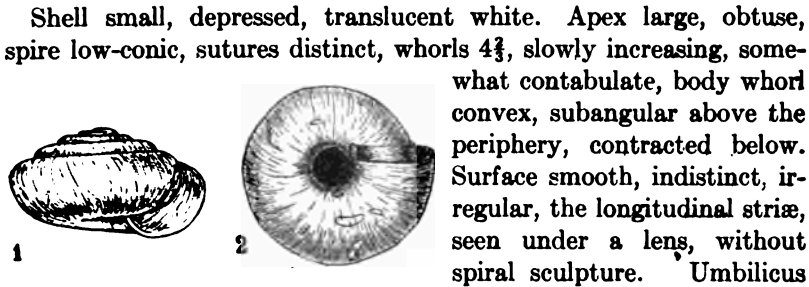
<sup>44</sup>Cerci and supra-anal plate drawn from paratype as they are flexed inward in type.



- Fig. 50.—*Aphemogryllus gracilis* new genus and species. Head and pronotum of male (type). Dorsal view. (Greatly enlarged.)
- Fig. 51.—*Aphemogryllus gracilis* new genus and species. Palpus of male (type). (Greatly enlarged.)
- Fig. 52.—*Aphemogryllus gracilis* new genus and species. Caudal tarsus and extremity of tibia of male. Internal face. (Greatly enlarged.)
- Fig. 53.—*Aphemogryllus gracilis* new genus and species. Ovipositor of female (allotype). ( $\times 11$ .)
- Fig. 54.—*Anaxipha esau* new species. Caudal tarsus and extremity of tibia of female (type). External face. (Greatly enlarged.)
- Fig. 55.—*Anaxipha esau* new species. Cephalic tibia of female (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)
- Fig. 56.—*Anaxipha simulacrum* new species. Dorsal field of tegmen of male (allotype). ( $\times 7$ .)
- Fig. 57.—*Anaxipha simulacrum* new species. Head and pronotum of female (type). Lateral elevation. (Greatly enlarged.)
- Fig. 58.—*Anaxipha simulacrum* new species. Cephalic tibia of female (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)
- Fig. 59.—*Anaxipha simulacrum* new species. Ovipositor of female (type). (Greatly enlarged.)
- Fig. 60.—*Anaxipha parænsis* new species. Dorsal field of tegmen of male (type). ( $\times 7$ .)
- Fig. 61.—*Anaxipha parænsis* new species. Palpus of male (type). (Greatly enlarged.)
- Fig. 62.—*Anaxipha parænsis* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)
- Fig. 63.—*Anaxipha fistulator* new species. Dorsal field of tegmen of male (type). ( $\times 7$ .)
- Fig. 64.—*Anaxipha fistulator* new species. Pronotum of male (type). Lateral elevation. (Greatly enlarged.)
- Fig. 65.—*Anaxipha fistulator* new species. Palpus of male (type). (Greatly enlarged.)
- Fig. 66.—*Anaxipha fistulator* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)
- Fig. 67.—*Anaxipha stramenticia* new species. Dorsal field of tegmen of male (type). ( $\times 7$ .)
- Fig. 68.—*Anaxipha stramenticia* new species. Head and pronotum of male (type). Lateral elevation. (Greatly enlarged.)
- Fig. 69.—*Anaxipha stramenticia* new species. Ovipositor of female (allotype). (Greatly enlarged.)
- Fig. 70.—*Anaxipha stramenticia* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)
- Fig. 71.—*Aphonomorphus surdus* new species. Dorsal field of tegmen of male (type). ( $\times 2\frac{1}{2}$ .)
- Fig. 72.—*Aphonomorphus surdus* new species. Head of male (type). Cephalic view. (Greatly enlarged.)
- Fig. 73.—*Aphonomorphus surdus* new species. Subgenital plate of male (type). Ventral view. (Greatly enlarged.)
- Fig. 74.—*Aphonomorphus surdus* new species. Cephalic tibia of male (type). Cephalic (left) and caudal (right) faces. (Greatly enlarged.)

## TWO NEW SHELLS FROM HAYTI.

BY E. G. VANATTA.

*Odontosagda abbotti* n. sp. Figs. 1, 2.

Shell small, depressed, translucent white. Apex large, obtuse, spire low-conic, sutures distinct, whorls  $4\frac{1}{2}$ , slowly increasing, somewhat contabulate, body whorl convex, subangular above the periphery, contracted below. Surface smooth, indistinct, irregular, the longitudinal striae, seen under a lens, without spiral sculpture. Umbilicus wide, deep, well-like, its width contained about 4.5 times in the diameter of the shell. Aperture lunate, peristome simple, acute, convexly arched above, depressed arcuate below. Columella slightly reflexed, parietal callus very thin. Palatal wall with traces of a callus at the periphery and base, near the peristome. At a distance of about one-fourth of a whorl within the aperture, two short, high, white teeth or lamellæ may be seen. These and a third tooth are visible through the translucent base. One very oblique transverse tooth is situated near the periphery, another longer one is placed spirally on the base, and traces of the third very short one may be indistinctly seen through the shell, on the columellar wall, close to the suture, within the umbilicus.

Alt., 1.22; diam., 2.1; aperture alt., .75; diam., .83 mm.

The types are in the collection of The Academy of Natural Sciences of Philadelphia, tray No. 118,240, from The General's Cave, one mile west of Jeremie, Hayti. Found in débris collected by Dr. W. L. Abbott at the base of a cliff about 300 yards from the seashore.

This species differs from *O. hilli* Pfr., of Cuba, which it resembles most in shape, by being smaller, the palatal lamellæ are shorter. The apex and umbilicus are also smaller. It also differs from *O. blandi* Weinl., of Hayti by having a more depressed spire, fewer whorls. It is also smaller, the palatal lamina near the periphery is not lunate the basal lamina is shorter and the umbilicus is larger.

*Obeliscus abbotti* n. sp. Fig. 3.

Shell elongate, subcylindrical, whorls 6, imperforate. Apex obtuse, very wide, large, suture impressed and crenulate, surface nearly smooth, under the lens irregularly longitudinally substriate. Aperture high, narrow, oval, outer lip, partially broken, thin, evenly arcuate, not very convex, base narrow, columella rather thick with an indistinct indication of a truncation at the base, parietal callus comparatively thick.

Alt., 5.56; diam., 1.5; aperture alt., 1.5; diam., .93 mm.

The types are in the Academy's collection, tray No. 118,244, from The General's Cave, west of Jeremie, Hayti. Found with the above species in débris collected by Dr. W. L. Abbott, in whose honor these two species are named.

*Obeliscus abbotti* differs from *O. swiftiana* Pfr. by being smaller, more cylindrical; the apex is more obtuse and the suture is crenulate.



**BIRDS OF THE PANAMA CANAL ZONE, WITH SPECIAL REFERENCE TO A COLLECTION MADE BY MR. LINDSEY L. JEWEL.**

BY WITMER STONE.

Through the generosity of several of its members the Academy of Natural Sciences has come into possession of a collection of some four hundred bird skins obtained by the late Lindsey Louin Jewel in the Canal Zone, Panama.

Mr. Jewel was stationed in the Zone from late in 1910 to the early part of 1913, engaged in engineering work, and had also been appointed Vice-Consul at Colon.

His beautifully prepared skins are accompanied by numerous notes on the habits, nests and eggs of many of the species. Unfortunately these do not cover all of the species, his death having prevented his return to the Zone, where he had hoped to complete his study of the bird life. They have, however, been used so far as they go in the following list, and as *all* the field notes, coloration of the soft points and description of the eggs and nests are to be credited to Mr. Jewel, it was thought unnecessary to make use of quotation marks; moreover, as there was frequently duplication in notes referring to several specimens of the same species, verbatim quotation was not practicable. Some few of Mr. Jewel's notes refer to specimens which were sent to the American Museum of Natural History, but they have been included wherever the species was unrepresented in the collection, Mr. W. DeW. Miller having kindly sent me a list of such specimens.

Mr. Jewel published an annotated list of the North American birds observed by him during his stay on the isthmus in *The Auk*, 1913, pp. 422-429, with a brief introduction describing the condition of the Zone at the time his collection was made, but did not identify any of the resident species. Some brief mention of his work and a list of birds of the Zone compiled by him from Ridgway's "Birds of North and Middle America" appeared in *The Canal Record* for January 28, 1914, pp. 219-220.

We have no record of a collection of birds having been made on the isthmus until 1847, when Lafresnaye described a number of specimens obtained there by DeLattre, a French collector, who was on his way to South America. This collection was purchased by Dr. Thomas B.

Wilson and is still preserved in this Academy, along with Dr. Wilson's other material. (*Revue Zoologique*, 1847, pp. 67-79.) No further collections were made in the Canal Zone so far as we are aware until the late fifties, when James McLeannan, of New York, who was stationed on the isthmus, began sending specimens to George N. Lawrence, who described them in the *Annals of the New York Lyceum of Natural History* and other scientific journals, issuing a final catalogue in three instalments. (*Ann. N. Y. Lyc. Vol. VII*, 1861-2, pp. 288-302, 315-334, 461-479, and *Vol. VIII*, pp. 294-360.)

During the winter of 1860-61 John R. Galbraith, son of William Galbraith, a well-known New York taxidermist, went to Panama and aided McLeannan in collecting for Mr. Lawrence. Some 390 species in all were obtained by the two collectors and their specimens are now in the American Museum of Natural History. In March, 1863, the noted British ornithologist, Osbert Salvin, visited McLeannan and in that year and later extensive collections were made for him and sent to England, all of which are now in the British Museum with the rest of the Salvin collection.

An account of the collections sent to him by McLeannan is published by Mr. Salvin in the *Proceedings of the Zoological Society of London*, 1864, pp. 342-373, and covers 272 species. From his introduction we learn that at the time of his visit McLeannan was track-master at Lion Hill (Loma del Leon) station on the Panama Railway, the second station after leaving Colon and about ten miles from the coast. It was situated "in the densest tropical forest, so wet that even in the dry season the trails were confined to the low hills, the swamps being impenetrable." Now we learn from Mr. Jewel that this famous locality is swallowed up in Gatun Lake.

In 1895, the Italian ornithologist Festa made a considerable collection at Punta de Sabana, Darien, and incidentally recorded a few species from Colon and Panama city.

In March, 1900, Mr. W. W. Brown, Jr., spent twenty-eight days at Loma del Leon, collecting for Mr. Outram Bangs, and secured 752 skins representing 148 species. He also secured a collection of 86 species in the vicinity of Panama city on the Pacific side of the isthmus, where the country is much drier with a scrubby growth.

At the same time that Mr. Jewel was making his collection Mr. E. A. Goldman visited the isthmus in the interests of the United States Biological Survey, but with the exception of descriptions of some new species obtained by him his collection has not yet been reported upon.

Mr. Jewel's collection represents 236 species and was made mainly

at Gatun, some three miles north of the historic Loma del Leon. Other localities where he collected were Agua Clara, Mindi and Mt. Hope, between Gatun and Colon; Toro Point, across the harbor from the latter city, and Ft. Lorenzo on the sea front just west of the Zone border. A few specimens were also secured at Tabernilla, almost half way across the isthmus, and at Pedro Miguel and Miraflores, nearer to Panama.

While the ornithology of the Canal Zone is supposed to be pretty well known, every large collection from the region contains a few species not hitherto reported, and in view of the increased interest in the country due to the opening of the canal it has seemed desirable to add to my report on Mr. Jewel's collection the names of such other species as have been recorded from the region, so that we may have a complete list of the avifauna. In making this compilation, in addition to the papers above quoted, the "British Museum Catalogue of Birds"; "Biologia Centrali-Americana" and Ridgway's "Birds of North and Middle America" have been consulted. It is possible that a few of the species recorded do not occur in the Canal Zone, as in some cases "Panama" has been understood as referring to the city while it may have been intended to denote the isthmus in general.

From the light that Dr. Frank M. Chapman has thrown upon the distribution of neotropical bird life in his "Distribution of Bird Life in Colombia" we now recognize the importance of what he terms "the Panama fault" and realize that many species are absent from the Canal Zone and its immediate vicinity which occur in the mountains of Chiriqui to the west and in the highlands of eastern Panama. As Chapman has shown, the subtropical and higher life zones are entirely lacking in the lower country of the Canal Zone, so that only the tropical fauna remains; subtropical species, therefore, which are usually quoted as occurring from Costa Rica to Ecuador have a gap in their range coextensive with the low ground of the isthmus.

In the list which follows the species not contained in the Jewel collection are placed in their proper systematic position, but have their numbers enclosed in brackets. North American migrants are marked with an asterisk.

#### TINAMIDÆ.

[1.] *Tinamus castaneiceps* Salvadori. Chestnut-headed Tinamou.

2. *Crypturus soui modestus* (Cabanis). Pileated Tinamou.

Female, Tabernilla, March 19, 1911. Iris brownish-yellow, bill fuscous lighter below, feet yellowish-green.

One of a pair flushed in a thicket by a stream. They usually run

and hide but fly strongly when forced, evidently common but hard to find. Have seen them also near Gatun. This bird contained an egg ready to lay, very large for the size of the bird.

#### ODONTOPHORIDÆ.

3. *Odontophorus gulanensis marmoratus* (Gould).

Two males, Gatun, September 3, 1911, and February 22, 1912. Iris brown, bare skin of face orange, bill black, feet dark greenish-slate.

On September 3, a covey of nine was flushed from rocks in the forest. They fly straight away when disturbed and are strong on the wing. Never seen in the open.

#### CRACIDÆ.

- [4.] *Crax panamensis* Ogilvie-Grant. Panama Curassow.

- [5.] *Penelope cristata* (Linnaeus). Crested Guan.

6. *Ortalis cinereiceps* (Gray). Gray-headed Guan.

Female, five miles south of Gatun, November 9, 1911. Iris grayish-brown, bill black-grayish at tip, feet steel-gray.

Shot from a flock of four.

#### COLUMBIDÆ.

- [7.] *Columba rufina pallidiorissa* (Chubb). Pale-vented Pigeon.

- [8.] *Columba subvinacea subvinacea* (Lawrence). Ruddy Pigeon.

- [9.] *Columba nigrirostris* Sclater. Short-billed Pigeon.

10. *Columba speciosa* Gmelin. Scaled Pigeon.

Male, Gatun, May 21, 1911. Iris brown, bill coral-red with white tip, feet purplish.

Found in a low flat thicket on the bank of Gatun dam and flew in rather labored manner for the forest.

11. *Chaemopelia rufipennis rufipennis* (Bonaparte). Ruddy Ground Dove.

Male and female, Gatun, February 12 and 26, 1911. Iris red, bill light with darker tip, feet reddish-pink.

A very common species in low lands along streams, sometimes flying into the jungle growth when flushed. A nest found August 18, 1912, was a flat platform of twigs built on and between two fair-sized limbs of a tree eighteen feet from the ground in second-growth pasture. Eggs two, .89 x .65 and .86 x .66 ins.

12. *Chaemopelia minuta elaeodes* Todd. Plain-breasted Ground Dove.

A pair, Miraflores, March 5, 1911. Iris light yellowish-brown, bill grayish, feet pink.

13. *Claravis pretiosa* (Ferrari-Peres). Blue Ground Dove.

A pair, Gatun, April 20, 1911. Iris light pinkish-yellow, bill greenish with a dark line on the culmen and gonys, feet pink.

Female was about to oviposit.

14. *Leptotila verreauxi verreauxi* (Bonaparte). Verreaux's Dove.

Two males, Gatun, May 28, and Minti, October 7, 1911. Iris light yellowish-orange, bill black, feet coral red, circumorbital area deep blue.

The latter specimen is largely in the juvenal plumage.

The call of this bird was a single "coo," very deceptive as to distance, and in quality resembling two notes of a chord.

15. *Leptotila cassini cassini* (Lawrence). Cassin's Dove.

A male from Gatun, August 6, 1911; female, Trinidad River, March 12, 1911. Iris light yellow, bill black, circumorbital space coral-red, feet red.

Found in the forest along the trails. This bird has a peculiar habit of bobbing the head and tail, but the movement is not a movement of the entire body as in the sandpipers.

Nest a frail platform of sticks in a large bush, overhanging the trail through a heavily overgrown pasture, at Gatun. Egg, 1.15 x .83 ins.

[16.] *Oreopeleia montana* (Linnaeus). Ruddy Quail Dove.

#### RALLIDÆ.

17. *Aramides cajanea* (P. L. S. Müller). Cayenne Wood Rail.

A male from the Chagres River, below Gatun, June 21, 1911, and a female from Gatun, April 28, 1912, are lighter colored than specimens from the Orinoco delta, especially as regards the gray of the throat and fore breast. Iris red, bill greenish at the tip passing into yellow basally, feet deep reddish-pink.

A nest found April 27, 1913, at Toro Point, on the edge of woods at the head of a small stream, was made from a bunch of leaves and trash lodged on top of the bushes, eight feet up. A few strips of dead banana leaves, some twigs and a few green leaves had apparently been added to the mass already there. There was one egg, 2.06 x 1.34 ins. The bird sat very close and would not leave until the bush was shaken.

\*18. *Porzana carolina* (Linnaeus). Sora.

A female from Toro Point, October 1, 1911. Iris reddish-brown, bill yellowish-green, tarsi greenish-olive.

Shot on the bare beach at the foot of a cliff.



**19. *Circus albigularis* (Lawrence). White-throated Crane.**

Two males secured at Gatun, April 4, 1911, and April 14, 1912; also a jet black downy young from the same locality, September 21, 1911, evidently only recently hatched. Adult: iris reddish-brown, bill sooty-black above green on the sides and lighter below, feet greenish-black. Young: iris black, bill white, feet brownish-horn.

Found in heavy grass in dry field near a marshy flat. Bird had a striking whistle of alarm and a "gathering call" when running similar to that of the Bobwhite.

**20. *Icthyophaga martinicus* (Linn).**

Female, Gatun Lake, July 9, 1911. Iris reddish-brown, bill bright red with greenish-yellow tip and purplish-blue frontal shield, feet yellow.

Flushed from a small grassy island, dove when shot, but stayed under water but a short time.

**HELIORNITHIDÆ.****21. *Helminthophila fulica* (Boddaert). American Finfoot.**

Female, Gatun Lake, February 23, 1913. Iris brown, lids red, bill red passing into white on lower part of the mandible, feet barred-black and yellowish-white.

A very shy bird. Its call is a peculiar "bark" of one to three notes. This specimen was nearly ready to incubate.

**COLYMBIDÆ.****[22.] *Colymbus dominicus brachyrhynchus* Chapman. Mexican Grebe.****LARIDÆ.****\*23. *Hydrochelidon nigra surinamensis* (Gmelin). Black Tern.**

Female, Gatun Lake, December 3, 1911. Iris brown, bill black, feet blackish-brown.

**\*24. *Sterna hirundo* Linnaeus. Common Tern.**

Male, shot from a flock, Gatun Lake, December 3, 1911, and a solitary female, from same locality, June 9, 1912 (in Amer. Mus. Nat. Hist.). Iris brown, bill black lighter at the tip and reddish at base, feet light orange-brown.

**CHARADRIIDÆ.****\*25. *Aegialitis semipalmata* (Bonaparte). Semipalmated Plover.**

A pair from Toro Point, July 23, 1911, shot from a flock of eight on the mud flats. Iris black, bill black with a narrow yellow-orange band from the nostrils underneath the mandible in a half ring, feet greenish-yellow.

It was also present, August 4, 1912, and September 4, 1911.

[36.] *Aegialitis collaris* (Vieillot). Collared Plover.

\*37. *Oxyechus vociferus vociferus* (Linnaeus). Killdeer.

One specimen, Gatun, February 18, 1912.

#### RECURVIROSTRIDÆ.

\*38. *Himantopus mexicanus* (P. L. S. Müller). Black-necked Stilt.

A female, Gatun, November 12, 1911. Iris reddish-brown, bill blackish, feet deep pink.

Observed for a week on the edge of the hydraulic fill of Gatun dam.

#### SCOLOPAIDIDÆ.

\*39. *Numenius hudsonicus* Latham. Hudsonian Curlew.

A female, Gatun, October 18, 1911, shot from flock of four feeding in a pasture on grasshoppers and butterflies. Iris brown, bill dusky-greenish becoming black at the tip, feet grayish-blue.

\*[40.] *Macrorhamphus griseus griseus* (Gmelin). Dowitcher.

\*[41.] *Totanus melanoleucus* (Gmelin). Greater Yellowlegs.

\*42. *Totanus flavipes* (Gmelin). Lesser Yellowlegs.

A solitary male obtained at Gatun, May 21, 1911, and a flock of half a dozen seen at the same place August 27, 1911. A female was also obtained at Mindi, October 7, 1911. Iris brown, bill black, feet yellow.

Frequented a grassy marsh below the dam.

\*43. *Helodromas solitarius solitarius* (Wilson). Solitary Sandpiper.

Female, Gatun, September 10, 1911 (not preserved); male, Mt. Hope, April 13, 1913. Iris brown, bill greenish becoming black terminally, feet green.

A flock of four were seen September 10 in a small running stream.

\*44. *Actitis macularia* (Linnaeus). Spotted Sandpiper.

Specimens obtained at Gatun, February 22, September 4 and October 1, 1911, and April 28, 1912; also at Pedro Miguel, April 23, 1911, Toro Point, August 4, 1912.

The individual obtained April 23 alighted on a dead tree top, four feet above the water, an unusual action in a wader.

\*45. *Bartramia longicauda* (Bechstein). Field Plover.

Two males, Gatun, October 12, 1911. Iris brown, bill yellowish with dusky tip, feet yellowish-green.

Flushed in an open field.

\*46. *Ereunetes pusillus* (Linnaeus). Semipalmated Sandpiper.

Female, Toro Point, September 4, 1911. Iris, bill and feet black.

One of a few associated with many *Pisobia minutilla* on the beach.

- \*37. *Tryngites subruficollis* (Vieillot). Buff-breasted Sandpiper.

One of a pair found on dry pasture land at Gatun, October 18, 1911. Iris brown, bill dusky-greenish, feet greenish.

- \*38. *Pisobia minutilla* (Vieillot). Least Sandpiper.

Two males, Toro Point, September 4, 1911. Iris brown, bill black, feet dusky-greenish.

Obtained from a flock of a dozen or more on the beach.

Another was obtained at Mt. Hope, August 31, 1913.

- \*39. *Pisobia maculata* (Vieillot). Pectoral Sandpiper.

Two females obtained at Mindi, in a grassy marsh, October 7 and 22, 1911. Iris black, bill blackish-green, feet greenish.

- \*[40.] *Pisobia fuscicollis* (Vieillot). White-rumped Sandpiper.

- \*41. *Gallinago delicata* (Ord.). Wilson's Snipe.

Male, Mindi, October 22, 1911, one of a bag of twelve killed in a grassy marsh. Iris brown, bill dusky-green tipped with black, feet yellowish-green.

#### JACANIDÆ.

42. *Jacana nigra* (Gmelin). Black Jacana.

Three specimens, male and female, Gatun Lake, July 9, 1911, where it was very common, and a female from Agua Clara, Trinidad River, March 12, 1911. A specimen in the American Museum of Natural History was obtained at Mindi, November 3, 1911. Iris greenish-yellow, bill greenish fading to pink at the base and yellow below at the base, frontal shield lavender, feet green washed with blue, wing spur bright yellow.

A common species on grassy knolls in the lake.

- [43.] *Jacana melanopygia* (Scoter). Black-rumped Jacana.

#### EURYPYGIDÆ.

- [44.] *Eurypyga major* Hartlaub. Greater Sun Bittern.

#### IBIDIDÆ.

- [45.] *Harpiprion cayennensis* (Gmelin). Cayenne Ibis.

#### OICONIIDÆ.

- [46.] *Mycteria americana* Linnaeus. Wood Ibis.

#### ARDEIDÆ.

- [47.] *Ardea herodias lessonii* Wagler. Great Blue Heron.

- [48.] *Egretta candidissima* (Gmelin). Snowy Egret.

- [49.] *Herodias egretta* (Gmelin). American Egret.

50. *Florida caerulea* (Linnaeus). Little Blue Heron.

Two males, Chagres River, below Gatun, February 19, 1911, one in

the immature white plumage, the other in the adult blue. Iris bright yellow, bill light blue shading to black at the tip, feet greenish.

A most abundant species, to be seen at almost any time in almost any quantity.

\*51. *Hydranassa tricolor ruficollis* (Gosse). Louisiana Heron.

Female, Gatun, February 18, 1912. Iris bright yellow, bill sooty-black on the culmen, pale yellow at the gonys, bare skin yellow, feet greenish.

\*52. *Nycticorax nycticorax naevius* (Boddaert). Black-crowned Night Heron.

An immature female, Mindi, October 29, 1911. Dull gray and somewhat streaked below, but with the top of the head and interscapulum greenish-black.

[53.] *Cochlearius seledoni* Ridgway. Zeledon's Boatbill.

[54.] *Ptilerodius pileatus* (Boddaert). Capped Heron.

55. *Butorides striata* (Linnaeus). Black-crowned Heron.

Two males, Gatun, June 9, 1912, and July 16, 1911. Iris bright yellow, bill black with yellow at the base and the gonys, feet yellow.

\*56. *Butorides virescens hypernotius* Oberholser. West Indian Green Heron.

Male, Gatun, September 17, 1911. Iris bright yellow, maxilla black with pale tomia, mandible greenish-yellow, feet greenish-yellow.

[57.] *Tigrisoma lineatum* (Boddaert). Tiger Bittern.

[58.] *Tigrisoma cabanisi* Heine. Cabanis' Tiger Bittern.

59. *Izobrychus exilis* (Gmelin). Least Bittern.

Female, Mt. Hope, September 13, 1913. Iris bright yellow, bill dusky above, yellow below, feet yellowish.

A crippled bird, nearly starved.

\*60. *Botaurus lentiginosus* (Montagu). American Bittern.

#### ANATIDÆ.

[61.] *Cairina moschata* (Linnaeus). Muscovy Duck.

[62.] *Dendrocygna autumnalis* (Linnaeus). Black-bellied Tree Duck.

\*[63.] *Anas platyrhynchos* Linnaeus. Mallard.

\*[64.] *Dafila acuta* (Linnaeus). Pintail.

\*65. *Querquedula discors* (Linnaeus). Blue-winged Teal.

Female, Mindi, October 22, 1911. Iris brown, bill greenish-black paler below, feet dull yellow with dark joints and webs.

This bird has rusty stains on the plumage of the entire lower parts. One of a flock on the Mindi marshes.

\*66. *Marila affinis* (Eyton). Lesser Scaup Duck.

Female, Gatun, November 25, 1911. Iris brown, bill blackish, feet bluish-gray with black joints and webs.

The species was abundant on Gatun Lake on November 26.

**PHALACROCORACIDÆ.**

67. *Phalacrocorax vigua vigua* (Vieillot). Brazilian Cormorant.

Female, Gatun Lake, December 17, 1911. One of a flock roosting in a dead tree in the water. It is in the brown immature plumage.

**SULIDÆ.**

68. *Sula leucogastra* (Boddaert). Booby.

Female in brown immature plumage secured at sea sixty miles north of Colon, December 4, 1910. Iris grayish-white, bill dark bluish-horn color lighter at the tip, tarsi bluish-white, feet yellowish.

**PELECANIDÆ.**

- [69.] *Pelecanus occidentalis* Linnaeus. Brown Pelican.

**FREGATIDÆ.**

- [70.] *Fregata minor palmerstoni* (Gmelin). Pacific Man-o'-war Bird.

**CATHARTIDÆ.**

- [71.] *Gypagus papa* (Linnaeus). King Vulture.  
 [72.] *Cathartes aura aura* (Linnaeus). Turkey Vulture.  
 [73.] *Catharista urubu* (Vieillot). Black Vulture.

**FALCONIDÆ.**

74. *Ibycter americanus* (Boddaert). Red-throated Caracara.

Male, Rio Indis, four miles from Gatun, November 19, 1911. Iris, bare skin of throat and face and tarsi orange red, claws black, bill yellow, cere grayish-blue.

- [75.] *Milvago chimachima* (Vieillot). Yellow-headed Caracara.  
 \*76. *Circus hudsonius* (Linnaeus). Marsh Hawk.

Female, Gatun, December 11, 1910. Iris dark brown, bill horn color black at tip, cere and feet yellow.

One of a pair which beat along the shores of Gatun Lake daily for a week or more. A common species in winter.

- [77.] *Micrastur melanoleucus* (Vieillot). Black and White Hawk.  
 [78.] *Micrastur mirandollei* (Schlegel).  
 79. *Micrastur guerilla interstes* Bangs. Cassin's Barred Hawk.

Male, Agua Clara, May 19, 1912, and female, Gatun, August 27, 1911, both in immature plumage, are referred to this species. The male is marked above with indistinct buff transverse spots on the wings and interscapulum and with narrow dark-brown bars below. The female is plain buff except on the sides of the breast and flanks, where there are a few transverse brown bands partially obscured by the buff feathers. Iris grayish-brown, cere yellowish or olive-green,

bill horn color, mandible yellow at base almost all yellow in female, feet yellow.

The latter bird was shot from a perch in low bushes in the forest near a small marshy stream. Its stomach was filled with remains of slugs, batrachians and small lizards.

[80.] *Geranospizias niger* (DuBus). Blackish Crane Hawk.

[81.] *Accipiter collaris* Kaup. Semi-collared Hawk.

[82.] *Accipiter bicolor* (Vieillot). Four-banded Hawk.

\*[83.] *Accipiter velox* (Wilson). Sharp-shinned Hawk.

\*84. *Buteo platypterus* (Vieillot). Broad-winged Hawk.

Adult male, Gatun, December 13, 1911, and female in striped plumage, Gatun, November 30, 1911. Iris grayish-brown, bill black bluish at the base, cere greenish-yellow, feet yellow.

Male shot in the heavy forest, the other in a clearing near the edge of the forest.

\*85. *Buteo swainsoni* Bonaparte. Swainson's Hawk.

Female, Mindi, October 22, 1911. Quite dark above and below. Iris brownish-gray, bill grayish-blue with dusky tip, cere dull greenish, feet pale yellow.

Another specimen was given to the U. S. Biological Survey.

86. *Asturina nitida* (Latham). Shining Buzzard Hawk.

Male, Gatun, November 3, 1911. This interesting specimen is in immature striped plumage and is referred to this species on the basis of comparison with adults, as I have no authentic specimens in this stage of plumage. The light bases and margins to the feathers of the head are pale buff, those of the back and wings more strongly rusty. Below the throat is nearly white, but the rest of the ground color tawny-buff. The brown spots are very coarse. The primaries are cream with blackish tips, with a rusty suffusion where the colors join. There are narrow dusky cross bars, fewer on the primaries than on the secondaries, so that the under part of the closed wing is almost uniform creamy buff, except for the dusky terminal portion. Iris grayish-brown, bill black, cere and feet yellow.

Stomach contained a large lizard and the gullet a fair sized mouse.

87. *Eupornis magnirostris ruficauda* (Scater and Salvin). Large-billed Hawk.

Female, Trinidad River, eight miles south of Gatun, March 24, 1912. Iris bright yellow, bill black, bluish at base, cere and feet yellow.

[88.] *Busarellus nigricollis* (Latham). Black-collared Hawk.

[89.] *Urubitinga urubitinga* (Gmelin). Brazilian Eagle.

**90. *Urubitinga anthracina* (Nitzsch). Mexican Black Hawk.**

Male, Ft. Lorenzo, January 7, 1912. Iris brown, bill blue-black, base and cere and feet yellow.

Shot from a palm tree. It had been feeding on carrion in the marsh.

**[91.] *Leucopternis semiplumbea* Lawrence. Semiplumbeous Hawk.****92. *Leucopternis ghiesbreghtii* (DuBus). Ghiesbreght's Hawk.**

Female, Gatun, February 22, 1911, and another not now in the collection, July 28, 1912. Iris dark brown, bill grayish-blue dusky at tip, cere and orbital ring bluish, feet pale yellow.

Shot in the thick forest. Had a peevish whistled note. Another female was shot previously at the same spot; it is always found in the jungle timber, and had apparently just deposited eggs.

**[93.] *Morphnus guianensis* (Daudin). Guiana Crested Eagle.****[94.] *Thrasaetus harpyia* (Linnaeus). Harpy Eagle.****[95.] *Spiziasstur melanoleucus* (Vieillot). Black and White Eagle.****[96.] *Spizaetus ornatus* (Daudin). Manduit's Hawk Eagle.****97. *Spizaetus tyrannus* (Wied.). Tyrant Hawk Eagle.**

Female, Gatun, February 4, 1912. Iris bright orange, bill blue-black, cere slaty, toes yellow.

Shot in the forest.

**98. *Harpagus bidentatus* (Latham). Double-toothed Hawk.**

Male, Gatun, June 9, 1912. Iris purplish-red, bill black, slaty on the sides and beneath, cere greenish, tarsi yellow.

**[99.] *Herpetotheres cachinnans* (Linnaeus). Laughing Hawk.****[100.] *Elaenoides forficatus* (Linnaeus). Swallow-tailed Kite.****[101.] *Leptodon uncinctus* (Temminck). Red-collared Kite.****[102.] *Ictinia plumbea* (Gmelin). Plumbeous Kite.****\*[103.] *Falco columbarius* Linnaeus. Pigeon Hawk.****104. *Falco albicularis* Daudin. White-throated Hawk.**

Female, Toro Point, August 4, 1912. Iris brown, bill black, blue-gray at base, cere and feet rich yellow.

Shot flying along the beach.

**\*105. *Cerchneis sparveria sparveria* (Linnaeus). Sparrow Hawk.**

Male, Gatun, January 29, 1911. Several others killed and given away—March 5, 1911, April 4, 1911.

**[106.] *Pandion haliaetus carolinensis* (Gmelin). Osprey.****TYTONIDÆ.****107. *Tyto peralta guatemalae* (Ridgway). Central American Barn Owl.**

Male, Gatun, August 1, 1911. Iris black, bill whitish ivory.

One of a pair living in ventilators of a building in the town. Always came out at dusk and flew in the same direction.

## BUBONIDÆ.

- [108.] *Rhinoptynx clamator* (Vieillot). Striped Horned Owl.  
 [109.] *Otus choliba* (Vieillot). Cholibá Screech Owl.  
 [110.] *Otus vermiculatus* (Ridgway). Vermiculated Screech Owl.  
 [111.] *Pulsatrix perspicillata perspicillata* (Latham). Spectacled Owl.  
 [112.] *Ciccaba nigrolineata nigrolineata* Selater. Black and White Owl.  
 [113.] *Ciccaba virgata virgata* Cassin. Cassin's Owl.

## PSITTACIDÆ.

114. *Ara macao* (Linneus). Scarlet Macaw.

A cage bird said to have been taken on the upper Trinidad.

- [115.] *Ara chloroptera* Gray. Red, Blue and Green Macaw.  
 [116.] *Ara ambigua* (Bechstein). Buffon's Macaw.  
 [117.] *Ara severa* (Linneus). Severe Macaw.  
 [118.] *Eupsittula ocularis* (Selater and Salvin). Veragua Parrot.  
 [119.] *Pyrrhula haematotis coccinellaris* (Lawrence). Red-necklaced Parrot.  
 [120.] *Amazona autumnalis salvini* (Salvadori). Salvin's Parrot.  
 [121.] *Amazona ochrocephalus panamensis* (Cabanis). Panama Parrot.  
 122. *Amazona farinosa inornata* (Salvadori). Plain-colored Parrot.

Female, Gatun, June 4, 1911. Iris brown in young bird, red in adult; bill horn color with yellowish spot on side, cere grayish becoming darker with age, feet dark gray becoming yellow in adult, bare skin of chin and around the eye white.

Found in heavy forest sitting motionless in a large tree with two others, probably young. Gullet was filled with very hard white seeds.

123. *Pionus menstruus* (Linneus). Blue-headed Parrot.

Female, Trinidad River, near Agua Clara, March 12, 1911. Iris brown, bill lighter at base and with a large red spot on the sides of the mandible, cere black.

A noisy species.

124. *Brotopogon jugularis* (Müller). Tovi Parrakeet.

Two females, Gatun, May 14, and Toro Point, April 2, 1911. Iris brown, bill and feet light gray-brown, cere very light ashy.

Remarkably swift in flight and usually shy.

## ALOEDINIDÆ.

125. *Streptoceryle torquata torquata* (Linneus). Ringed Kingfisher.

Female, Chagres River, four miles below Gatun, February 19, 1911. Eyes black, bill black, feet bluish-black.

Found all along the river. They are comparatively shy and hard to approach, dashing out of the foliage and holding close to the shore in the shadow of the banks.



\*126. *Streptoceryle alcyon alcyon* (Linnaeus). Belted Kingfisher.

Male, Toro Point, October 1, 1911. Iris brown, bill black, feet dark brown.

One of six or eight migrants.

127. *Chloroceryle amazons* (Latham). Amazon Kingfisher.

Male, Gatun River, July 8, 1911. Iris brown, bill and feet black. Shot three miles up the river, well into the forest.

128. *Chloroceryle americana isthmica* (Goldman). Isthmian Green Kingfisher.

Two females, Gatun, January 29 and April 18, 1911; male, Chagres River, near the sea, June 11, 1911. Iris dark brown, bill and feet black.

The most common Kingfisher.

[129.] *Chloroceryle inda* (Linnaeus). Green and Rufous Kingfisher.

130. *Chloroceryle aenea aenea* (Pallas). Least Green Kingfisher.

Male, Gatun, July 9, 1911. Iris black, bill black with pale stripe on the gonys, feet sooty-brown.

### MOMOTIDÆ.

131. *Urospatha martii semirufa* (Sclater). Greater Rufous Motmot.

Male, Gatun, August 18, 1912. Iris dark brown, bill and feet black.

Stomach contained a small red crab, entire.

132. *Momotus subrufescens conexus* (Thayer and Bangs). Small-billed Motmot.

Male, Gatun, March 17, 1912. Iris reddish-brown, bill black, feet flesh color.

133. *Electron platyrhynchus minor* (Hartert). Lesser Broad-billed Motmot.

Two males, Gatun, August 20, 1911, and April 28, 1912. Iris brown, bill and feet black.

Found in heavy forest.

[134.] *Hylomanes momotula obscurus* Nelson. Panama Tody Motmot.

### NYOTIBIIDÆ.

135. *Nyctibius griseus panamensis* Ridgway. Panama Potoo.

Male, Gatun, August 11, 1912. Iris golden yellow, bill blackish, feet light brown.

[136.] *Nyctibius grandis* (Gmelin). Great Potoo.

### CAPRIMULGIDÆ.

137. *Nyctidromus albicollis albicollis* (Gmelin). Parauque.

Male and female, Gatun, February 5, 1911, and April 7, 1912. Iris brown, bill brown, feet gray-brown.

May be flushed from the ground in almost any medium thick growth,

where it rests in the shade. Female specimen flushed from eggs laid on the bare ground on an old path. They measured 1.10 x .84 and 1.12 x .86 ins.

[138.] *Stenopels cayennensis albicauda* (Lawrence). White-tailed Stenopels.

[139.] *Antrostomus rufus rufus* (Boddaert). Rufous Goatsucker.

\*140. *Chordeiles virginianus virginianus* (Gmelin). Nighthawk.

Female, Gatun, October 3, 1911. Bill black, tarsi grayish.

One of a flock feeding overhead.

\*141. *Chordeiles acutipennis texensis* (Lawrence). Texas Nighthawk.

Male and female, Gatun, December 10, 1911.

#### MICROPODIDÆ.

142. *Chaetura cinereiventris fumosa* (Salvin). Smoky Swift.

Male, Gatun, May 14, 1911.

One of a flock feeding along the base of a hill over a wild banana plantation. Sexual organs well developed.

143. *Chaetura chapmani* Hellmayr. Chapman's Swift.

Two females, Gatun, July 9, 1911. Iris dark-brown, bill black, tarsi sooty-brown.

Two of a large flock feeding over the jungle below Gatun dam. This seems to be the first record of this species from Panama.

This species was described by Mr. Hellmayr (Bull. Brit. Orn. Club, xix, p. 62, 1907) from a Trinidad specimen collected by Dr. F. M. Chapman and recorded by him as *C. cinereicauda* Cassin (Bull. Amer. Mus. Nat. Hist., 1895, p. 324). Before describing it as distinct Mr. Hellmayr sent me a specimen of this and allied forms for comparison with Cassin's type. As he has stated, I found Cassin's specimen to be identical with *C. brachyura* (Jardine). At the same time I found a specimen of the proposed *C. chapmani* in the Academy collection, and a comparison of this with the Panama specimens before me positively confirms my identification. This extends the range of the species northward, as it was previously known only from Trinidad and French Guiana according to Hellmayr.

#### TROCHILIDÆ.

144. *Threnetes ruckeri* (Bourcier). Rucker's Hermit.

Two males, Gatun, February 12, 1911, and January 28, 1912. Iris black, maxilla black above with a narrow yellow strip on each side from the base, mandible yellow with a black tip, feet pink.

A bird of the jungle, a noisy species.

**145. *Glaucis hirsuta affinis* (Lawrence). Lesser Hairy Hermit.**

Two males and a female, Gatun, February 5 and May 7, 1911, and April 30, 1911. Iris black, maxilla black, mandible yellow with black tip, feet flesh color.

A bird of the thick jungle, always well below the top foliage.

Four nests found April 30 hung on blades of thorny palm leaves fastened with cobweb. May 7, one nest contained two pure white eggs, .35 x .61 and .34 x .62 in.

**146. *Phoebastria adolphus saturatus* Ridgway. Dusky Hermit.**

Two males, Gatun, April 9, 1911. Iris black, maxilla black, mandible bright yellow abruptly black near tip, feet flesh color.

Frequently seen but always near the same spot, a stretch of jungle just west of Gatun dam. They seldom fly over twelve inches from the ground, usually under the foliage, darting about like bees. They are very noisy, chirping constantly one note at a time and then several rapid notes of varying pitch. This sounds so like several birds that I have more than once crept close and looked long to find a single individual perched on a leaf stem a few inches from the ground, beating his little tail up and down as though he would break himself in two and chirping away for dear life. Once I saw one leave a leaf stem about eight inches from the ground and hanging on invisible wings revolve around and around as if he were a weight suspended at the end of a thread, first one way and then the other as if winding and unwinding. Then with great energy he flew in a figure eight back and forth over the same path, and the figure was not over eighteen inches long. (Jewel.)

**147. *Phoebastria longirostris cephalus* (Bourcier and Mulsant). Nicaraguan Hermit.**

Two males and a female, Gatun, February 12, May 7 and 30, 1911. Iris black, bill black with base of mandible yellow, feet pink.

A bird of the thick jungle. Its nest was hung on the underside of a broad leaf at the pendant tip. It was a compact cup of grass stalks wrapped onto the leaf tip with spiders' webs, the nest tapering down below the end of the leaf. The bird sits facing the leaf with his bill pointed straight up against it. The broad point of the leaf arches overhead like a roof. (Jewel.)

**148. *Phaethon cuvieri cuvieri* (DeLattre and Bourcier). Cuvier's Hummingbird.**

Two males, Gatun, April 14, 1914. Iris brown, bill black, basal half of mandible pink, feet black.

**149. *Florisuga mellivora* (Linnaeus). Jacobin Hummingbird.**

Two males and two females, Gatun, April 14, May 30, and April 9, May 21, 1911. Iris, bill and feet black.

Stomach filled with very small insects of a greenish metallic lustre. A bird of the jungle.

**150. *Folyerata amabilis*** (Gould). Lovely Hummingbird

Three males, Gatun, January 1, February 11, 1912, and April 9, 1911. Iris dark brown, bill black yellowish below with black tip, feet black.

Shot in the jungle.

**151. *Lepidopygia caeruleocularis*** (Gould). Duchassain's Hummingbird.

Three males and a female, Gatun, March 2, 1911, and May 30, August 11, 1912; two other males, Mt. Hope, August 31, 1913, and Ft. Lorenzo, January 7, 1912. Iris and feet black, maxilla black, mandible pink with a black tip.

**152. *Saucerottia edwardi*** (DeLattre and Bourcier). Wilson's Hummingbird.

Three males, Gatun, April 14, 1911 (2), March, 1912. Iris, feet and maxilla black, mandible pale tipped with black.

Obtained in the forest.

**[153.] *Saucerottia niveoventer*** (Gould). Snowy-breasted Hummingbird.

**154. *Amazilia tsacatl tsacatl*** (De la Llave). Rieffer's Hummingbird.

Two males and two females, Gatun, July 4, 1911, May 30, 1912, and May 7, 1911, January 14, 1912. Iris and feet black, bill black purplish about the nostrils and below.

A nest found April 30 was on the horizontal limb of a shrub, five feet from the ground, a dainty cup of light yellow silky vegetable fiber, with a few gray lichens on the outside, all held together by a network of spiders' webs. Contained two fresh eggs May 7. Another nest about fifteen feet from the ground in similar situation found May 7 contained one egg and one young bird. (Jewel.)

It seems to the writer that it will be necessary to revert to the generic name *Amazilia* Lesson for these birds. When Dr. Oberholser proposed to adopt *Amizilis* Gray (Proc. Acad. Nat. Sci. Phila., 1899, p. 206) he asked me to verify some references for him and through a misunderstanding a quotation from Gray's large work, "Genera of Birds," was quoted as from his "List of Genera of Birds, 1840." This, however, does not affect the main question and is mentioned in order to correct an obvious error for which I am mainly responsible.

The generic name *Amizilis* does occur in Gray's 1840 "List" as correctly quoted in the 1910 edition of the "A. O. U. Check-List," i. e., p. 14, with the following as its basis:

*A. latirostris* (Sw.) n. Ois. M., pl. 12. *Or. amizili* Less.

The A. O. U. committee accepted *Orthorhynchus amizili* Less. as the type on the basis of Gray's use of it alone in his 1855 edition of the

"List." As a matter of fact, in all editions of the "List" we find on the title page "with an indication of the typical species of each genus" and the citation of a species in any edition is rightly regarded as a type designation for the genus under which it is quoted. Where two names are cited as above the second is obviously intended as a synonym of the first and is usually a reference to a plate or figure of the species. Gray's own statement on the title page, moreover, proves that he was citing but a single species under each genus.

In the present case he misidentified the *Cynanthus latirostris* of Swainson, thinking it the same as *Orthorhynchus amizili* Lesson, and did not correct his error until the 1855 edition. Upon this basis *C. latirostris* becomes the type of *Amizilis* Gray, 1840, which, therefore, becomes a synonym of *Cynanthus* Swainson, 1827.

*Amazilia* Lesson, L'Echo du Monde Sav. ser. 2, viii, No. 32, Oct. 22, 1843, col. 757, seems to be the first name available for the present genus. Mr. Ridgway (Birds of N. and Mid-America, vol. V, p. 405) quotes five species as mentioned by Lesson, and of these I would designate *Ornismia cinnamomea* Less. (= *O. rutila* DeLattre) as the type of *Amazilia* Lesson.

155. *Hylocharis eliciae* (Bourcier and Mulsant). Elicia's Golden-tail.

Male, Gatun, July 28, 1912. Iris black, bill bright red, terminal third black, feet blackish.

[156.] *Damophila panamensis* Berlepsch. Panama Hummingbird.

157. *Chlorostilbon assimilis* Lawrence. Allied Emerald.

Male and female, Gatun, April 5, 1912, and October 14, 1911. Iris and feet black, maxilla black, mandible orange-brown tipped with black.

158. *Thalurania colombica colombica* (Bourcier). Colombian Wood Nymph.

Four males and two females, Gatun, May 14, June 4 (2), 1911, February 4, 1912, and May 28, 1911, July 28, 1912. Iris and bill black the latter yellowish at extreme base, feet black, under side of toes pink.

Found in the jungle.

[159.] *Chalybura buffoni* (Lesson). Buffon's Plumeleteer.

160. *Anthracothorax nigricollis nigricollis* (Vieillot). Black-throated Mango.

Two males and a female, Gatun, May 14, 21 and 28, 1911. Iris, bill and feet black.

In wild banana thickets on the edge of the jungle.

[161.] *Heliothryx barroti* (Bourcier and Mulsant). Barrot's Fairy.

[162.] *Anthracoceros longirostris longirostris* (Vieillot). Long-billed Star-throat.

[163.] *Lophornis delattrei* (Lesson). DeLattre's Coquette.

[164.] *Popelairia converdi aequatorialis* (Berlepsch and Taczanowski). Salvin's Thorn-tail.

#### TROGONIDÆ.

165. *Curucujus massena* (Gould). Massena Trogon.

Two males and two females, April 13, 1911, March 2, 1913, and June 11, 1911, March 2, 1913. Iris brownish-yellow in male, brown in female, bill red in male; mandible yellow, maxilla black in female, feet grayish-brown.

Female, June 11, contained an egg nearly ready to deposit, pure glossy white.

[166.] *Curucujus melanurus macrourus* (Gould). Large-tailed Trogon.

[167.] *Curucujus clathratus* (Salvin). Lattice-tailed Trogon.

168. *Trogon strigilatus chionurus* (Selater and Salvin). White-tailed Trogon.

Male, Gatun, September 3, 1911. Iris dark brown, eyelids light blue, bill dull yellowish-green with a sooty terminal area, feet whitish.

Found in open forest.

169. *Chrysotrogon caligatus* (Gould). Gartered Trogon.

Male, Rio Trinidad, March 31, 1912. Iris brown, eyelids yellow, bill greenish-gray.

170. *Trogonurus curucui tenellus* (Cabanis). Graceful Trogon.

Two males and a female, Gatun, August 6 (pair), December 3, 1911. Iris brown or black, eyelids grayish-blue, bill yellowish-green, feet grayish-lead.

Found in heavy forest.

#### CUOULIDÆ.

\*171. *Coccyzus americanus americanus* (Linnaeus). Yellow-billed Cuckoo.

Female, Mindi, October 22, 1911.

172. *Flaya cayana thermophila* (Selater). Central American Squirrel Cuckoo.

Female, Toro Point, March 3, 1912. Iris red, eyelids greenish-yellow, bill greenish-yellow, feet blackish-slate.

[173.] *Neomorphus salvini* Selater. Salvin's Ground Cuckoo.

174. *Coccyus rutila panamensis* (Todd). Panama Cuckoo.

Male, Gatun, February 27, 1912. Iris and eyelids red, bill greenish-yellow, feet greenish-gray, mouth black inside.

[175.] *Dromococcyx phasianellus* (Spix). Pheasant Cuckoo.

[176.] *Crotophaga sulcirostris* Swainson. Groove-billed Ani.

177. *Crotophaga ani* Linnaeus. Ani.

A pair, Gatun, August 11, 1912, and a male, Mt. Hope, June 1, 1913. Iris brown, bill and feet black.

A nest belonging to these birds in bush three feet from ground, a

bulky cup of sticks, weed stalks with rootlets inside, and a few green leaves partly covering the eggs, which were five in number, 1.37 x 1.01 to 1.46 x 1.05 ins., blue covered with white chalky deposit. The bird slipped off and crawled away through the weeds.

178. *Tapera naevia excellens* (Selater). Northern Striped Cuckoo.

Male, Gatun, November 5, 1911. Iris light reddish-brown, maxilla brown, black on the culmen, mandible pale-horn, feet grayish-blue. Stomach filled with grasshoppers.

#### CAPITONIDÆ.

179. *Capito maculicoronatus maculicoronatus* Lawrence. Spotted-crowned Barbet.

Male, Mt. Hope, February 22, 1913. Iris brown, bill and feet blue-gray.

#### RAMPHASTIDÆ.

[180.] *Ramphastos swainsonii* Gould. Swainson's Toucan.

[181.] *Ramphastos ambiguus* Swainson. Wagler's Toucan.

182. *Ramphastos piscivorus brevicarinatus* (Gould). Short-tailed Toucan.

Two males, Gatun, July 4 and 30, 1911. Iris bottle-green, bill yellowish-green with a triangular orange streak on the side of the maxilla, mandible bluish at base shading into the yellowish-green subterminally, ends of both blood red, a narrow black band all around the base, bare skin around the eye and throat green, feet bluish-green.

Call is loud and piercing, repeated rapidly and almost constantly.

[183.] *Selenidera spectabilis* Cassin. Cassin's Aracari.

184. *Pteroglossus torquatus torquatus* (Gmelin). Collared Aracari.

Male, Gatun, February 22, 1911. Iris bright yellow, bare skin around the eye and lores dark red, bill with a narrow white band around the base, mandible dark-horn color with one light spot beneath, maxilla black at end with a black stripe the full length of the culmen, sides lighter with reddish-brown shading near base, edge of "teeth" black, feet olive-green.

Shot on the edge of the jungle.

#### GALBULIDÆ.

[185.] *Jacamerops aurea* (Müller). Great Jacamar.

#### BUCCONIDÆ.

186. *Notharchus tectus subtectus* (Selater). Black-breasted Puff Bird.

Three females, Gatun, January 27, 28, 1912, and March 2, 1913. Iris brown, bill black, feet blue-black.

Stupid birds found in second growth, usually feeding on termites' nests, fluttering to the nest and then back to their perches.

[187.] *Notharchus hyperhynchus dysoni* (Scater). Dyson's Puff Bird.

[188.] *Notharchus pectoralis* (Gray). Black-breasted Puff Bird.

[189.] *Ecchaunornis radiatus fulvidus* (Salvin and Godman). Fulvous Puff Bird.

190. *Malacoptila panamensis panamensis* Lafresnaye. Panama Malacoptila.

Male, Agua Clara, May 19, 1912, and female, Gatun Lake, March 30, 1913. Iris red, bill dusky above greenish below, feet grayish-green.

[191.] *Monasa fidelis* Nelson. Golden Nun Bird.

[192.] *Monasa similis* Nelson. Cerro Azul Nun Bird.

[193.] *Nonnula frontalis* Scater. Panama Nonnula.

#### PICIDÆ.

194. *Centurus subelegans wagleri* (Salvin and Godman). Wagler's Woodpecker.

Three males, Tabernilla, March 19, Miraflores, March 5, and Toro Point, April 2, 1911, and female, Gatun, September 10, 1911. Iris brown, bill black, feet dark olive.

The specimen taken March 19 was one of a brood just leaving a nest in a dead stub about eighteen feet from the ground in an open field. Another nest in a hole, fifteen feet up in dead stub, April 28, 1912, contained two eggs, .94 x .70 and .93 x .69 in.

195. *Melanerpes pucherani pucherani* (Malherbe). Pucherani's Woodpecker.

Two males, Gatun, April 4 and May 30, 1911. Iris brown, bill black, feet greenish-gray.

First bird had nest hole in dead tree in a clearing.

[196.] *Chloronerpes callopterus* Lawrence. Panama Woodpecker.

197. *Ceolus loricatus loricatus* (Reichenbach). Fraser's Woodpecker.

A pair, Mindi, October 22, 1911. Iris reddish-brown, bill pale greenish-yellow with dusky culmen, feet gray-green.

198. *Ceophloeus lineatus mesorhynchus* (Cabanis and Heine). Panama Pileated Woodpecker.

Male, Mt. Hope, August 31, 1913, and male, Gatun, November 12, 1911. Iris yellowish-white, bill brown, feet grayish-blue.

199. *Scapanus malherbei* (Gray). Malherbe's Woodpecker.

A pair, Gatun, November 12, 1911. Iris golden-yellow, bill brown, feet grayish-blue.

200. *Picuminis olivaceus panamensis* Ridgway. Panama Piculet.

Female, Gatun, May 28, 1911. Iris brown, bill black, feet greenish. Young male, Mindi, September 17, 1911.

#### FORMICARIIDÆ.

201. *Cymbilaimus lineatus fasciatus* Ridgway. Fasciated Ant-Shrike.

Female, Gatun, May 26, 1912. Iris carmine, bill black above gray below, feet blue-gray.



**202. *Taraba transandana transandana* (Slater). Holland's Ant-Shrike.**

Male, Rio Siri, twenty miles from Gatun, November 19, 1911, and female, Gatun, March 29, 1911. Iris brownish-orange, bill black, feet bluish-gray. Female, Gatun, March 29, 1911. Iris red-orange.

Stomach of latter specimen contained many ants and a lizard three inches and a half in length, the legs and tail of which had been cut off and swallowed separately.

**203. *Thamnophilus radiatus nigricristatus* (Lawrence). Black-crested Ant-Shrike.**

Male, Tabernilla, March 19, 1911. Iris dull greenish-yellow, bill black above, bluish below, feet dark-bluish. Female, Gatun, April 30, 1911. Iris light yellow.

Found in clearings near the jungle.

**204. *Erionotus punctatus atrinucha* (Salvin and Godman). Slaty Ant-Shrike.**

Two males and two females, Gatun, July 30, 1911, February 11, 1912, and May 7, May 30, 1911. Iris brown, bill black above blue-gray below, feet grayish-blue.

Nest found May 7, 1911, in the horizontal fork of a horizontal limb, twelve feet from the ground, in a thick jungle. A very frail and pensile cup of grass stalks covered over on the sides loosely but heavily with fuzzy green moss, bottom so thin that there seemed danger of the eggs falling through. Contained one egg, .64 x .85 in., white, with a broad wreath of rufous brown spots at the larger end.

A bird of the jungle.

**205. *Microrhopias boucardi virgata* (Lawrence). Panama Ant-Wren.**

Female, Gatun, January 21, 1912. Iris black, bill black with blue tomial stripe, feet blue-gray.

A noisy, active, arboreal species, an inhabitant of the jungle.

**206. *Myrmotherula surinamensis* (Gmelin). Surinam Ant-Wren.**

Female, Rio Siri, March 31, 1912. Iris brown, bill brownish-black paler below, feet blue-gray.

Found in a clearing along the bank of the river. Nest pensile at end of slender branch six feet from ground, made of fine grasses with curtain of green moss on exposed side. Eggs two, July 13, 1912, .67 x .51 and .69 x .53 in., grayish-white, heavily speckled, mottled and washed with shades of cinnamon-brown, with a heavier wreath around the larger end.

**[207.] *Myrmotherula pygmaea* (Gmelin). Pigmy Ant-Wren.****208. *Cercomacra nigricans* Slater. Black Tyrannine Antbird.**

Two males, Colon, February 25, 1913, Toro Point, August 4, 1912. Iris brown, bill black, feet slaty.

**200. *Carcomacra tyrannina tyrannina* (Scater).** Tyrannine Antbird.

Female, Gatun, July 30, 1911. Iris grayish-brown, bill black above pale grayish-brown below, feet blue-gray.

Shot in a forest thicket.

**[210.] *Myrmopagis melaena* (Scater).** Black Ant-Wren.

**211. *Myrmopagis fulviventrís* (Lawrence).** Lawrence's Ant-Wren.

Three males and a female, Gatun, May 14, 1911, January 21, July 21, 1912, and June 25, 1911. Iris light yellow, bill bluish-black lighter below, feet pinkish, toes blue.

Found in low wet forest, near the ground, creeping about the shrubbery like a warbler or vireo.

**212. *Myrmeciza boucardi panamensis* Ridgway.** White-bellied Antbird.

Male and female, Tabernilla, March 19, 1911, and Pedro Miguel, May 5, 1912. Iris reddish-brown, bill black, feet pale.

The pair collected March 19 had their stomachs filled with ants and I watched them for some time hopping back and forth along a trail of leaf-cutter ants.

**213. *Myrmeciza exsul exsul* Scater.** Scater's Antbird.

Two males and a female, Gatun, July 2, 1911, March 24, 1912, and August 6, 1911. Iris brown, skin around the eye blue, bill black, feet bluish-gray.

A noisy species, inhabiting the thick jungle.

**214. *Ramphocaenus rufiventris rufiventris*.** Northern Long-billed Ant-Wren.

Female, Gatun, June 25, 1911. Iris brown, bill grayish-brown, feet blue-gray.

A forest bird.

**[215.] *Microbatas cinereiventris semitorquatus* (Lawrence).** Half-collared Ant-Wren.

**[216.] *Anaplopes bicolor* (Lawrence).** Bicolored Ant-Thrush.

**217. *Gymnocichla nudiceps nudiceps* (Cassin).** Bare-crowned Antbird.

Two males, Gatun, February 5 and April 9, and one Tabernilla, April 8, 1911. Iris dark brown, bill black, feet blue-gray.

Several individuals were seen in the jungle climbing along roots and low stems; never saw one on the ground.

**218. *Hylophylax naevioides* (Lafresnaye).** Spotted Antbird.

Two males, Gatun, May 14 and August 20, 1911. Iris brown, bill black, feet blue-gray.

Nest found in fork of small bush in the forest, about four feet from the ground, a thin pensile cup containing two nearly feathered young.

**219. *Formicarius moniliger panamensis* Ridgway.** Panama Antbird.

Female. Iris brown, bill black, feet brownish, bare skin pale bluish-gray.

[230.] *Phaenostictus mcleannani mcleannani* (Lawrence). McLeannan's Ant-Thrush.

231. *Pittasoma michleri michleri* Cassin. Michler's Ant-Pitta.

Male and female, Gatun, July 21, 1912, and August 13, 1911. Iris brown, bill black whitish below, feet blue-gray.

A shy species found in the heavy jungle. Had a very loud penetrating whistled call, "qua, qua, qua," etc., slower toward the end, gave it several times on the ground and then flew to a perch about twenty feet up and repeated it several times more.

[232.] *Myloperus perspicillatus perspicillatus* (Lawrence). Lawrence's Antbird.

#### DENDROCOLAPTIDÆ.

[233.] *Synallaxis pudica pudica* Sclater. Slaty Synallaxis.

234. *Automolus pallidigularis pallidigularis* Lawrence. Pale-throated Automolus.

Male, Gatun, August 13, 1911. Iris brown, bill dusky-horn, feet grayish-olive.

Shot on the ground in the forest. Nest on open tops of twigs, dead leaves, etc., lined with fine grass, slightly elbow-shaped, and about twelve inches long; situated in a tree fork, seven feet up; eggs, two fresh, .83 x .62 in.

235. *Xenops genibarbis mexicanus* (Sclater). Mexican Xenops.

Three males, Gatun, November 30, 1911, January 21 and May 26, 1912. Iris brown, bill black, feet dark blue-gray.

Found in the forest.

236. *Sclerurus guatemalensis* (Hartlaub). Guatemalan Sclerurus.

Two males, Gatun, August 20, 1911, and February 22, 1912. Iris dark brown, maxilla black, mandible pale brownish-yellow with dusky tip, feet blackish-brown.

Nest found August 20 was elbow-shaped, made of twigs, leaf skeletons, weed stalks, rootlets, etc., lined with fine leaf skeletons and four feathers. Eggs, .97 x .64 and .92 x .61 in., glossy white, smaller one very sparingly specked with deep rich brown, larger one more heavily marked with spots and specks of olive-brown.

[237.] *Sclerurus mexicanus mexicanus* Sclater. Mexican Sclerurus.

238. *Glyphorhynchus cuneatus pectoralis* (Sclater). Northern Wedge-bill.

Male and female, Gatun, July 21, 1912, and March 22, 1911. Iris brown, bill blackish, feet bluish-black.

Found creeping about tree trunks in heavy jungle.

[239.] *Deconychura typica* Cherrie. Cherrie's Dechonicura.

[240.] *Dendrocincila homochroa ruficeps* (Sclater and Salvin). Panama Ruddy Dendrocincila.

241. *Dendrocincila lafresnayi ridgwayi* (Oberholser). Brown Dendrocincila.

Two males, Gatun, May 21 and August 20, 1911. Iris grayish-brown, bill black, gonyes light blue, feet blue.

In company with the next species on tree trunks in the forest.

[232.] *Dendrocolaptes sancti-thomae sancti-thomae* (Lafresnaye). Barred Wood-Hewer.

[233.] *Xiphorhynchus punctigulus punctigulus* (Ridgway). Spotted-throated Wood-Hewer.

234. *Xiphorhynchus nanus nanus* (Lawrence). Lawrence's Wood-Hewer.

Two males and two females, May 21 and June 25, 1911; March 29, 1911, and July 21, 1912. Iris brown, bill blackish, feet bluish-horn color.

A rather common forest bird.

235. *Xiphorhynchus lacrimosus lacrimosus* (Lawrence). Black-striped Wood-Hewer.

Female, Gatun, November 12, 1911. Iris brown, maxilla horn color, mandible pale bluish-white, feet bluish-gray.

Shot from a tree trunk in the submerged area of Gatun Lake.

[235.] *Picolaptes lineaticeps lineaticeps* Lafresnaye. Streaked-headed Wood-Hewer.

237. *Campylorhamphus venezuelensis* (Chapman). Venezuelan Sicklebill.

Male, Gatun, April 14, 1911. Iris brown, bill light reddish-brown, feet fuscous.

Was picking dead wood from the rotted end of a tree limb, searching for boring insects or larvæ.

#### TYRANNIDÆ.

238. *Copurus leuconotus* Lafresnaye. White-backed Copurus.

Male and female, Gatun, February 18, 1912. Iris brown, bill and feet black.

[239.] *Placostomus superciliaris* (Lawrence). Lawrence's Spade-billed Flycatcher.

240. *Craspedoprion aequinoctialis* (Selater). Equinoctial Flycatcher.

Two females, Gatun, December 18, 1910, and August 6, 1911. Iris black, bill black above pinkish below, feet gray-blue.

Found in wild banana thickets and in the forest.

[241.] *Rhynchocyclus marginatus* Lawrence. Yellow-margined Flycatcher.

[242.] *Rhynchocyclus cinericeps* (Selater). Gray-headed Flycatcher.

243. *Rhynchocyclus flavo-olivaceus* Lawrence. Yellow-olive Flycatcher.

Male and female, Gatun, July 2 and May 28, 1911. Iris brownish-gray, bill black above whitish below, tarsi grayish-brown.

A forest species.

Nest hung loosely from a branch over the water, composed of a mass of very long brown fibers, entrance from the bottom, passage extending up about eight inches to nest proper, which was compactly built; contained three young May 28. Another nest exactly like this one was placed a few feet below, close to the water and contained one egg, light reddish-brown, with deeper colored spots forming a wreath at the larger end. The lower nest had been water-soaked. The female specimen was sent to the American Museum of Natural History.

**244. *Myiopagis placens accola* Bangs. Panama Placid Flycatcher.**

Male, Gatun, October 17, 1911. Iris brown, bill brown above pale below, feet brownish-black.

Shot from a small hedge near the lake shore. Specimen not in the collection.

**245. *Todirostrum cinereum finitimum* Bangs. Northern Tody Flycatcher.**

Male and female, Gatun, February 27, 1912, and April 21, 1911. Iris light yellow, bill black, base and tip of mandible white.

Nest found late in March, suspended from tip of twig ten feet from the ground, pendile and shaped like an inverted pear, opening on the side at about one-third the height. Nest ten and a half inches high and three in outside diameter at bottom, made of plant fibers, weed bark and fine grasses, covered on exposed side with brown fuzzy seeds. Progress in building was very slow but on April 21 it contained two eggs, .46 x .63 in. Two other nests contained two eggs each—April 30, 1911, and June 23, 1912.

**[246.] *Todirostrum nigriceps* Sclater. Black-headed Tody Flycatcher.****247. *Todirostrum schistaceiceps* Sclater. Slate-headed Tody Flycatcher.**

Male and female, Pedro Miguel, May 5, 1912, and a male, Gatun, February 16, 1912. Iris brown, bill black paler below, feet blue-gray.

**[248.] *Oncostoma cinereigulare* (Sclater). Bent-billed Flycatcher.****249. *Oncostoma olivaceum* (Lawrence). Lawrence's Bent-billed Flycatcher.**

Two males and a female, March 26, November 3 and November 26, 1911. Iris yellowish-white, bill dusky paler below, feet grayish.

Has a peculiar clear note, a short song or trill of several notes. Found in the dry jungle and in groves.

**250. *Atalotriccus pilaris pilaris* (Cabanis). Pigmy Flycatcher.**

Two males, Pedro Miguel, April 23, 1911, and May 5, 1912. Iris yellowish-white, bill dusky paler below, feet pale-brownish.

Found in second growth. Call a trill, resembling the last syllable of the Wood Pewee's note (*Myiochanes virens*) prolonged.

**251. *Pipromorpha oleaginea parca* (Bangs). Bangs' Pipromorpha.**

Two males and a female, Gatun, July 4, November 30, May 14, 1911. Iris brown, bill black lighter below, feet brownish-flesh.

A forest species.

Nest found May 14 hung on a long slender vine between the trunks of large trees, about six feet up. A long pear-shaped structure with entrance on the side, made of green moss and fine grasses. Eggs three, pure white, .58 x .78, .57 x .76 and .56 x .75 in.

**253.** *Mionectes olivaceus olivaceus* Lawrence. Olivaceous Mionectes.

Male, Gatun, August 20, 1911. Iris brown, bill black paler basally and below, feet light grayish-brown.

Found in the forest.

[253.] *Leptopogon pileatus* Cabanis. Brown-capped Leptopogon.

[254.] *Leptopogon flavovirens* Lawrence. Yellow-green Leptopogon.

[255.] *Capsiempis flaveola* (Lichtenstein). Yellow Flycatcher.

[256.] *Tyranniscus villosissimus parvus* (Lawrence). Lesser Paltry Flycatcher.

**257.** *Camptostoma pusillum flaviventre* (Selater and Salvin). Yellow-bellied Camptostoma.

Two males, Gatun, April 21, 1911, and May 26, 1912. Iris brown, bill fuscous paler below, tarsi black.

Shot from a small tree in an open marshy flat.

**258.** *Elaenia martinica subpagana* (Selater and Salvin). Northern Elaenia.

Two females, Gatun, April 21, 1912, and Pedro Miguel, April 23, 1911. Iris brown, bill fuscous lighter below, feet blackish.

Found on the edge of swampy thickets.

Nest found April 23 saddled on a horizontal limb eight feet from the ground; a shallow and compact cup three inches in diameter, made of fine rootlets, twigs, etc., covered with green moss and gray lichens and lined with dove feathers. Two eggs, .64 x .86 in., white, with small cinnamon-brown blotches and spots in a wreath at the larger end. Another nest at Mt. Hope, April 13, 1913, was exactly like this one; eggs, two.

**259.** *Elaenia chiriquensis chiriquensis* Lawrence. Lawrence's Elaenia.

A male and female, Gatun, July 2, 1911, January 27, 1912, and a female, Miraflores, March 5, 1911. Iris brown, bill fuscous lighter below, feet bluish-black.

**260.** *Legatus albicollis* (Vieillot). Striped Flycatcher.

Male, Gatun, May 2, 1911. Iris brown, bill and feet black.

Shot on the edge of the jungle.

[261.] *Sublegatus glaber* Selater and Salvin. Smooth Flycatcher.

**262.** *Myiozetetes cayanensis cayanensis* (Linnaeus). Cayenne Flycatcher.

Three females, Gatun, January 29, May 21 and July 16, 1911. Iris brown, bill and feet black.

Nest adorned like others of the genus and contained one egg March 17, 1912, .62 x .87 in. Another, May 21, 1911, contained three eggs, .63 x .84 and .64 x .85 in.

Found in a marshy thicket. On January 29 there was a large flock feeding in the tree tops in wet woodland.

**263.** *Myiozetetes texensis columbianus* (Cabanis and Heine). Colombian Flycatcher.

Two males and two females, February 12, April 9, 1911, and April 14, 1911, April 21, 1912. Iris light yellow, bill and tarsi black.

A bird of the open, and never found far from water.

Nest on horizontal stem of a bush leaning over the water, eight feet above the surface, constructed of plant bark, weed stalks and grasses, lined with very fine grass, bulky but compact, opening on side, nearly spherical, six inches in diameter. Contained three fresh eggs April 9, .64 x .90 and .68 x .94 in., white, finely speckled with cinnamon-brown. Another exactly similar nest found April 14 in same situation held two fresh eggs.

**264. *Myiozetetes granadensis* Lawrence.** Gray-capped Flycatcher.

Male, Gatun, July 2, 1911. Iris gray, bill and feet black.

Nest as in the last species.

Found in thickets.

**265. *Pitangus lictor* (Lichtenstein).** Lictor Flycatcher.

Female, Gatun, July 9, 1911. Iris brown, bill and feet black.

Contained an egg nearly ready for deposit.

[266.] ***Coryphotriccus albobittatus* (Lawrence).** White-ringed Flycatcher.

**267. *Myiodynastes maculatus nobilis* (Scater).** Noble Flycatcher.

Two males and a female, Gatun, November 26, 1911, March 30, 1913, and November 30, 1911. Another not in the collection was taken January 21, 1912. Iris brown, bill black above pinkish below with black tip, feet bluish-black.

Found in the jungle and in clearings along the edge.

[268.] ***Myiodynastes luteiventris* Scater.** Sulphur-bellied Flycatcher.

**269. *Megarynchus pitangus mexicanus* (Lafresnaye).** Boat-billed Flycatcher.

Female and young, Ft. Lorenzo, June 2, 1911. Iris brown, bill and feet black.

Nest belonging to these birds was a shallow mass of sticks, thirty-five feet up in a tree.

[270.] ***Onychorhynchus mexicanus fraterculus* Bangs.** Colombian Royal Flycatcher.

[271.] ***Cnipodectes subbrunneus* (Scater).** Brown Flycatcher.

[272.] ***Cnipodectes minor* Scater.** Lesser Brown Flycatcher.

**273. *Terenotriccus erythrurus fulvicularis* (Salvin and Godman).** Fulvous-throated Flycatcher.

Two females, Gatun and Rio Trinidad, August 6, 1911, March 31, 1912. Iris brownish-black, bill sooty above whitish below, feet buffy.

Found in the forest.

**274. *Myiophobus fasciatus fufureus* (Thayer and Bangs).** Bran-colored Flycatcher.

Male and female, Gatun, March 26 and November 3, 1911. Iris brown, bill black lighter below, feet black.

In second growth thickets and in thick jungle.

**275. *Myiobius barbatus atricaudus* (Lawrence).** Black-tailed Myiobius.

Male and female, Gatun, June 25 and August 13, 1911. Iris black, bill black above, mandible grayish-blue with black tip, feet dark gray.

In thickets on the forest edge. Nest a pendant bell-shaped structure with entrance beneath the passage going up and over into the nest cavity; made of dead leaves and fine vegetable fiber, lined with vegetable silk and fine fibers. Situated on a branch overhanging a stream in the forest. Eggs two, rich deep rufous, wreathed about the larger end with deeper shade of the same, .65 x .50 in.

Another pair found building July 30 had finished their nest by August 6. Eggs two, .64 x .50 and .67 x .50 in. Location and materials exactly as in the former one.

[276.] *Myiobius xanthopygus sulphureipygus* (Scater). Sulphur-rumped Myiobius.

\*[277.] *Empidonax flaviventris* (Baird). Yellow-bellied Flycatcher.

\*[278.] *Empidonax virescens* (Vieillot). Acadian Flycatcher.

[279.] *Empidonax albigularis* Scater and Salvin. White-throated Flycatcher.

\*[280.] *Empidonax minimus* (Baird). Least Flycatcher.

\*[281.] *Empidonax traillii traillii* (Audubon). Traill's Flycatcher.

\*[282.] *Empidonax traillii alnorum* Brewster. Alder Flycatcher.

\*[283.] *Myiochanes richardsoni richardsoni* (Swainson). Western Wood Pewee.

\*[284.] *Myiochanes virens* (Linnaeus). Wood Pewee.

Male, Gatun, November 3, 1911. Iris brown, bill black above yellow below, feet black.

One of several migrants, calling repeatedly. Specimen not in the collection.

[285.] *Myiochanes brachytarsus* (Scater). Short-legged Wood Pewee.

Two males and two females, Gatun, January 14, 1912, February 16, 1913, and April 4, 1911, January 1, 1912. Iris brown, bill black above, mandible rich yellow, feet black.

Found in trees in low flat jungle. Note very similar to that of the preceding but with weaker accent.

\*[286.] *Myiarchus crinitus* (Gmelin). Great-crested Flycatcher.

**287. *Myiarchus ferox panamensis* (Lawrence).** Panama Flycatcher.

Two males, Ft. Lorenzo, June 11, and Toro Point, July 23, 1911. Iris brown, bill and feet black.

Found in low bushes along the river bank and seashore.

**288. *Myiarchus nigriceps* Scater.** Black-crested Flycatcher.

A pair, Gatun, February 4, 1912, and a male, Gatun, November 26, 1911. Iris brown, bill and feet black.



**289. *Tyrannus dominicensis dominicensis* (Gmelin). Gray Kingbird.**

Female, Gatun, February 16, 1912. Bill and feet black.

**\*290. *Tyrannus tyrannus* (Linnaeus). Kingbird.**

Female, Toro Point, April 27, 1913.

A solitary migrant, perfectly silent.

**291. *Tyrannus melancholicus satrapa* (Cabanis and Heine). Lichtenstein's Kingbird.**

Two males and two females, Gatun, December 3, February 5, 1911, and February 12, March 26, 1911. Iris brown, bill black, feet blue-black.

A very common species in shrubbery along the lake, apparently always near water.

Nest a thin cup of vine stalks and tendrils in a bush, five feet up, contained three eggs March 20, 1912, .98 x .71, .99 x .70 and .98 x .72 in.

**292. *Muscivora tyrannus* (Linnaeus). Swallow-tailed Flycatcher.**

Female, Mindi, October 29, 1911. Iris brown, bill and feet black. Shot from a small tree in a pasture.

#### PIPRIDÆ.

**293. *Pipra mentalis ignifera* Bangs. Southern Yellow-thighed Manakin.**

Three males, Gatun, April 30, August 27, 1911, and February 22, 1912.

Found in trees in low flat jungle.

**294. *Pipra velutina* Berlepech. Velvety Manakin.**

Female, Gatun, July 30, 1911. Iris brown, bill black above grayish below, feet blue-black.

A bird of the forest.

**[295.] *Chiroprion lanceolata* (Wagler). Sharp-tailed Manakin.**

**[296.] *Laniocera rufescens* (Solater). Rufous Manakin.**

**297. *Manacus vitellinus* (Gould). Gould's Manakin.**

Three males and a female, Gatun, February 22, April 9 and 14, 1911, and April 14, 1911. Iris and bill black, feet reddish-orange.

Always found in fairly thick jungle. Flies with wing beats almost as rapid as those of a hummingbird, seen in shrubs and bushes, never high up nor on the ground. Makes a snapping noise exactly like knocking two stones together and another sound like tearing heavy cloth.

Nest hung on a fork of a horizontal twig of a small bush five feet from the ground, a very frail shallow cup, made of strips of plant bark, hair-like rootlets and grass stalks. Eggs two, heavily incubated (April 14), .62 x .82 in., grayish, heavily streaked longitudinally with varying shades of brown. Another nest contained two fresh eggs May 7, 1911.

## COTINGIDÆ.

299. *Tityra semifasciata costaricensis* Ridgway. Costa Rican Tityra.

Male, Ft. Lorenzo, February 26, 1911, and female, Gatun, February 23, 1913. Iris reddish, bare skin around the eye and base of bill red, tip of bill black, feet gray.

Found along the shores of the lake and river.

[299.] *Erator albitorques* (DuBus). Fraser's Erator.

[300.] *Platyparis homochrous* (Scater). One-colored Becard.

301. *Fachyrhamphus polychropterus cinereiventris* (Scater). Gray-billed Becard.

Male and female, Gatun, June 25 and 18, 1911. Iris black, bill blue-gray with black tip, feet blue-black.

Nest found June 18 in a crotch of a small tree twenty-five feet from the ground, an enormous pile of strips of dead banana leaves, plant fibers, weeds, bark, etc. A small opening on one side. Eggs three, two of which hatched the same day. The young are hatched naked and blind, reddish in color. Eggs grayish-lavender, streaked and scrawled with deeper brownish.

[302.] *Fachyrhamphus dorsalis* Scater. Bogota Becard.

303. *Fachyrhamphus cinereus* (Boddaert). Cinereous Becard.

Male, Gatun, May 26, 1912. Iris brown, bill blue-gray with black tip, feet light gray.

304. *Fachyrhamphus cinnamomeus* Lawrence. Cinnamon Becard.

Two males, Gatun, July 4, 1911, and February 22, 1912. Iris brown, bill black above, mandible blue-gray, feet blue-gray.

Found in the forest.

[305.] *Microtriccus brunneicapillus* (Lawrence). Brown-capped Tyrannulet.

306. *Tyrannulus elatus reguloides* (Ridgway). Riker's Yellow-crowned Tyrannulet.

Male, Toro Point, March 3, 1912. Iris buffy-white, feet grayish-blue.

307. *Elainopsis gaimardii macdillainii* (Lawrence). McIlvaine's Flycatcher.

Male, Gatun, July 4, 1911. Iris brown, bill blue-black lighter at base below, feet blue-black.

Found along the forest trail. Has a quaint single call of Flycatcher quality.

I follow Mr. Ridgway in placing this genus in the Cotingidæ, though I cannot but feel that its affinities are with the Tyrannidæ.

[308.] *Lipaugus holerythrus holerythrus* Scater and Salvin. Rufous Lipaugus.

[309.] *Lathria unirufa clara* Ridgway. Panama Lathria.

[310.] *Sirystes albogriseus* (Lawrence). Panama Sirystes.

311. *Attila citreopygus citreopygus* (Bonaparte). Scater's Attila.

Male, Gatun, July 2, 1911. Iris gray-brown, bill sooty-black paler at base of mandible, feet blue.

A dull stupid bird, perching high up in the forest.

[312.] *Cotinga nattererri* (Boissoneau). Natterer's Cotinga.

313. *Querula purpurata* (Müller). Purple-throated Fruit Crow.

Male and female, Gatun, June 23, 1912. Iris brown, bill blue-gray black at tip, feet black.

It flocks in the forest, a shy species.

#### HIRUNDINIDÆ.

\*314. *Riparia riparia* (Linnaeus). Bank Swallow.

Male, Gatun, September 23, 1911.

Shot from a flock of migrants.

315. *Iridoprocne albilineata* (Lawrence). Mangrove Swallow.

Two males and a female, Gatun, July 17, May 30, 1911, and July 17, 1911. Iris brown, bill blue-black, feet black.

Common along the Chagres River, where it nests in holes in partly submerged stumps.

316. *Pygochelidon cyanoleuca* (Vieillot). Blue and White Swallow.

Male and female, Gatun, July 7 and 16, 1911. Iris dark brown, bill and feet black.

On the former date a flock was coursing over the lawns and clearings. On the latter some two hundred were lined up on a telephone wire.

[317.] *Neochelidon tibialis* (Cassin). White-thighed Swallow.

\*318. *Hirundo erythrogaster* Boddaert. Barn Swallow.

Male and female, Gatun, April 20 and May 30, 1911.

A common migrant through April. The unusually late female specimen showed a breeding tendency, as several eggs were well started. It was associated with a flock of *Iridoprocne albilineata*.

319. *Fregata chalybea chalybea* (Gmelin). Gray-breasted Martin.

Male, Gatun, February 4, 1912. Another was obtained at the same place April 13, 1911, but is not in the collection. Iris brown, bill and feet black.

Nest in holes usually inaccessible on account of the mud and water.

\*[320.] *Petrochelidon lunifrons tachina* Oberholser. Lesser Cliff Swallow.

320a. *Stelgidopteryx serripennis* (Audubon). Rough-winged Swallow.

A male, Gatun, December 18, 1910, is typical of this species except for a slight subterminal dusky blotch on the longest under tail coverts. It is quite uniform above and is thus distinguished at a glance from specimens of *S. ridgwayi*. This occurrence is apparently farther south than any previously recorded.

**321. *Stelgidopteryx ruficollis uropygialis* (Lawrence).** Panama Rough-winged Swallow.

A male and two females, Gatun, July 9, 1911, and June 3, 1912, November 5, 1911. Iris brown, bill and feet dull black.

The last specimen has two pure white quills in the wing.

#### POLIOPTILIDÆ.

**322. *Polioptila superciliaris superciliaris* Lawrence.** Lawrence's Gnatcatcher.

Male, Gatun, January 1, 1912. Iris brown, bill black, mandible blue-gray at base, feet black.

Found in second growth.

#### TROGLODYTIDÆ.

**[323.] *Heleodytes albobrunneus* Lawrence.** White-headed Cactus Wren.

**324. *Thryophilus modestus elutus* Bangs.** Panama Wren.

Two males, Gatun, April 30 and December 24, 1911. Iris golden brown, bill black, mandible bluish-gray with black tip, feet blue-gray.

In thickets near the jungle.

**[325.] *Thryophilus rufalbus castanonotus* Ridgway.** Chestnut-backed Wren.

**326. *Thryophilus galbraithii galbraithii* (Lawrence).** Galbraith's Wren.

A pair, Gatun, June 23, 1912, and a male, Gatun, April 14, 1912. Iris reddish-brown, bill dusky paler below, feet blue-gray.

In thickets.

**327. *Thryophilus castaneus castaneus* (Lawrence).** Bay Wren.

Male, female and nestling, Gatun, February 18, March 15, 1911, and July 28, 1912. Iris reddish-brown, bill black lighter below, feet black.

Found in heavy undergrowth in damp jungle-thickets. Song loud and ringing, resembling that of *Thryothorus ludovicianus*, but much longer.

Nest a loosely built elbow-shaped affair, made almost entirely of a round-stemmed grass and lined with finer stems of the same, a few coarser stems and reddish-brown vine tendrils on the outside. Loosely placed in vines, four feet up, by a stream; contained one fresh egg, July 28, measuring .90 x .59 in.

**328. *Troglodytes musculus inquietus* (Baird).** Panama House Wren.

Male and female, Gatun, February 26, 1911; male, Gatun, September 17, 1911, and female and young, Ft. Lorenzo, June 11, 1911. Iris gray-brown, bill and feet brown.

In thickets along the lake shore, cocoanut groves, etc.

A nest was built in a floating boathouse, on a beam under the roof, made of weed stalks, small twigs and a few feathers inside. Also contained a small cast snake skin and part of a kodak film. The

first two eggs were destroyed and three more were laid June 5, light pink heavily speckled with rufous brown with wreath effect at large end, .74 x .56 and .75 x .55 in. After these were taken three more were laid and hatched. The boathouse was moved two hundred yards after the nest was built, but the birds were not disturbed by the change of location.

**329. *Henicorhina protheleuca pittieri* (Cherrie).** Pittier's Wood Wren.

Male, Gatun, February 22, 1912. Iris brown, bill and feet black.

**330. *Leucolepis lawrencii* (Sclater).** Lawrence's Musician Wren.

Male and female, Gatun, July 30, 1911, and April 9, 1911. Iris brown, bill black, feet light brown, bare skin around the eye bluish-green.

A bird of the jungle.

Nest found in low wet forest two feet from the ground on May 7, 1911. It consisted of a long tube or tunnel with the nest proper at the far end, built of sticks, twigs and dead leaves, lined with grasses. Eggs two, .65 x .92 and .65 x .89 in., white, very finely and sparingly speckled with brown, one almost immaculate.

**[331.] *Pheugopedius hyperythrus* (Salvin and Godman).** Tawny-bellied Wren.

**332. *Pheugopedius fasciato-ventris albigularis* (Sclater).** Panama Black-bellied Wren.

Male, Gatun, June 25, 1911. Iris bright brown, bill black bluish-gray below, feet bluish-gray.

Shot in a jungle thicket on a small stream.

**[333.] *Microcerculus luscini* Salvin.** Panama Nightingale Wren.

#### MIMIDÆ.

**[334.] *Dumetella carolinensis* (Linneus).** Catbird.

#### TURDIDÆ.

**335. *Planesticus grayi castus* (Bonaparte).** Bonaparte's Thrush.

Male, Miraflores, March 5, 1911; female, Pedro Miguel, May 5, 1912. Iris dark brown, bill dark yellow greenish at base, feet pale yellow.

Call note resembles that of the American Robin (*P. migratorius*). Frequents tall trees in the jungle.

Nest in fork of a small tree in second growth timber, twelve feet from the ground, Pedro Miguel, April 23, 1911; a typical cup with base of weed and cattle manure, and built of twigs, straw, dead leaves and moss, with a lining of rootlets and tendrils. Eggs three, fresh, .86 x 1.24 and .88 x 1.23 ins., greenish-blue heavily marked with various shades of brown, mainly at the larger end.

Another nest in same vicinity, May 5, 1912, contained three incubated eggs, 1.12 x .83 and 1.13 x .84 ins. A third set of three measured 1.04 x .72 and 1.06 x .73 ins.

[336.] *Pianesticus obsoletus* (Lawrence). Lawrence's Thrush.

\*[337.] *Hylocichla ustulata swainsonii* (Cabanis). Olive-backed Thrush.

\*[338.] *Hylocichla fuscescens fuscescens* (Vieillot). Veery.

#### VIREONIDÆ.

339. *Vireosylva flavoviridis flavoviridis* Cassin. Yellow-green Vireo.

Male, Agua Clara, May 19, 1912. Iris red, bill and feet pale blue-gray.

\*[340.] *Vireosylva olivacea* (Linnaeus). Red-eyed Vireo.

\*[341.] *Lanivireo flavifrons* (Vieillot). Yellow-throated Vireo.

342. *Pachysylvia viridiflava* (Lawrence). Yellow-green Pachysylvia.

Male, Mt. Hope, February 22, 1913; female, Gatun, May 30, 1912. Iris whitish yellow, bill and feet pinkish.

343. *Pachysylvia aurantifrons aurantifrons* (Lawrence). Lawrence's Pachysylvia.

Male, Pedro Miguel, May 5, 1912.

Shot from a tree in a wild banana jungle.

344. *Pachysylvia decurtata* (Bonaparte). Gray-headed Pachysylvia.

Male and young, Gatun, July 4 and June 25, 1911. Iris dark brown, bill gray-brown, feet bluish-gray.

Found in the forest.

[345.] *Vireolanus pulchellus viridiceps* Ridgway. Panama Shrike-Vireo.

\*[346.] *Bombycilla cedrorum* Vieillot. Cedar Waxwing.

[347.] *Anthus parvus* Lawrence. Panama Pipit.

#### MNIOTILTIDÆ.

\*348. *Mniotilta varia* (Linnaeus). Black and White Warbler.

Male, Gatun, March 26, 1911.

\*349. *Protonotaria citrea* (Boddaert). Prothonotary Warbler.

Male, Toro Point, October 1; female, Mindi, October 7, 1911.

\*[350.] *Vermivora chrysoptera* (Linnaeus). Golden-winged Warbler.

\*[351.] *Vermivora peregrina* (Wilson). Tennessee Warbler.

\*[352.] *Dendroica magnolia* (Wilson). Magnolia Warbler.

\*[353.] *Dendroica coronata* (Linnaeus). Myrtle Warbler.

\*[354.] *Dendroica virens* (Gmelin). Black-throated Green Warbler.

\*[355.] *Dendroica cerulea* (Wilson). Cerulean Warbler.

\*[356.] *Dendroica fusca* (Müller). Blackburnian Warbler.

\*357. *Dendroica pennsylvanica* (Linnaeus). Chestnut-sided Warbler.

Two males and one unsexed, Gatun, March 31, 1911 (molt completed), February 4, 1912 (molt begun), February 22, 1912.

\*358. *Dendroica castanea* (Wilson). Bay-breasted Warbler.

Three males, Gatun, November 3, 1911 (2), and Toro Point, April 27, 1913, and one unsexed, Gatun, February 16, 1913.

\*359. *Dendroica aestiva aestiva* (Gmelin). Yellow Warbler.

Four males and two females, Gatun, March 26 (2), March 29, November 5, 1911, and August 29 and December 24, 1911.

\*360. *Dendroica erithachorides* Baird. Panama Yellow Warbler.

Four males, Mt. Hope, February 9 and August 31, 1913, and Toro Point, July 23 and October 1, 1911. Iris black, bill and feet olive-brown.

In bushes along the shore.

\*361. *Oporornis formosus* (Wilson). Kentucky Warbler

Female, Gatun, February 22, 1911.

\*362. *Oporornis philadelphia* (Wilson). Mourning Warbler.

Male and female, Gatun, April 7 and 14, 1912. (Male not in the collection.)

[363.] *Oporornis tolmiei* (Townsend). McGillivray's Warbler.

\*364. *Seiurus aurocapillus* (Linnaeus). Ovenbird.

Female, Gatun, November 26, 1911.

\*[365.] *Seiurus motacilla* (Vieillot). Louisiana Water Thrush.

\*366. *Seiurus noveboracensis noveboracensis* (Gmelin). Water Thrush.

Male, Gatun, March 29, 1911; female, Gatun, April 14, 1911.

Found regularly all winter.

\*367. *Wilsonia canadensis* (Linnaeus). Canada Warbler.

Male, Gatun, April 28, 1912.

\*[368.] *Wilsonia citrina* (Boddaert). Hooded Warbler.

\*369. *Setophaga ruticilla* (Linnaeus). Redstart.

Three males, Gatun, March 26 and November 26, 1911, April 28, 1912; female, Gatun, April 14, 1912.

\*370. *Basileuterus rufifrons mesochrysus* (Sclater). Sclater's Warbler.

Male and an unsexed specimen, Gatun, April 7, 1912, and Pedro Miguel, April 23, 1911. Iris brown, bill fuscous, feet light flesh-color.

\*371. *Basileuterus semicervinus veraguensis* (Sharpe). Buff-rumped Warbler.

Female, Rio Sírí, March 31, 1912. Iris brown, bill blackish.

Frequents river banks and overhanging tree-roots. Flits its wings like a Kinglet (*Regulus*), flashing its bright rump. Has a beautiful clear ringing song, somewhat like that of the Ovenbird (*Seiurus aurocapillus*), but more striking because the crescendo rises higher. The bird also walks like an Ovenbird and feeds along the water's edge like a Water Thrush (*S. noveboracensis*).

## FRINGILLIDÆ.

\*[372.] *Zamelodia ludoviciana* (Linnaeus). Rose-breasted Grosbeak.

373. *Cyanocompsa concreta cyanescens* Ridgway. Panama Blue Grosbeak.

Two males and a female, Gatun, July 30, 1911; August 11, 1912; June 18, 1911. Iris brown, bill bluish-horn color, feet black.

Nest a frail cup of fine twigs lined with vine tendrils in crotch of bush five feet up in a thicket. Eggs two, bluish-white, wreathed heavily at the larger end with reddish and purplish brown, .82 x .71 in.

A bird of thickets and heavy forest.

374. *Oryzoborus funereus* Sclater. Lesser Rice Grosbeak.

Male, Ft. Lorenzo, June 21, 1911.

Associates with the next.

375. *Sporophila aurita* (Bonaparte). Hicks' Seedeater.

Three males and three females, Gatun, March 22, April 13, December 24, 1911; June 25, 1911, June 2 and August 11, 1912. Iris brown, bill blackish-horn, feet gray-brown.

Nest a thin-walled cup, made entirely of fine reddish-brown tendrils, situated in the terminal twigs of a small sapling, fifteen feet from the ground. Eggs two, heavily incubated (June 25), white, very heavily marked all over with brown and with some wash of lavender at the larger end, .66 x .51 in. Another nest August 11, 1912, contained two eggs nearly fresh, .69 x .53 and .70 x .53 in.

Occurs in flocks of a dozen feeding on seeds in grass and shrubbery in open places and in second growth.

[376.] *Sporophila grisea schistacea* (Lawrence). Slate-colored Seedeater.

[377.] *Sporophila minuta minuta* (Linnaeus). Minute Seedeater.

[378.] *Sporophila gutturalis* (Lichtenstein). Yellow-bellied Seedeater.

379. *Tiaris olivacea pusilla* (Swainson). Mexican Grassquit.

Male and female, Gatun, December 24, 1911, and April 7, 1912. Iris brown, bill horn-brown, feet gray-brown.

Common in second growth.

380. *Volatinia jacarini splendens* (Vieillot). Blue-black Grassquit.

Three males and two females, March 22 and November 26, 1911, July 21, 1912; April 13 and December 24, 1911. Iris black, bill black above bluish below, feet blue-black.

Flocks with *Sporophila aurita*.

Nest (July 21, 1912) in clump of weeds, two feet from the ground, a frail thin-walled cup of fine vine tendrils or rootlets. Eggs two, fresh, pale bluish or greenish-white heavily spotted with brown, lavender and burnt umber, denser at the larger end, .69 x .51 and .68 x .51 in.

[381.] *Amaurospiza concolor* Cabanis. Cabanis' Seedeater.



**333.** *Pitylus grossus* (Linnaeus). Slate-colored Grosbeak.

Male, Gatun, June 25, 1911. Iris dark brown, bill salmon-pink, tarsi dull black.

Found in clearing in the forest.

[333.] *Caryothraustes pollogaster scapularis* Ridgway. Lesser Bishop Grosbeak.

**334.** *Saltator magnoides intermedius* (Lawrence). Panama Buff-throated Saltator.

Female, Gatun, April 30, 1911. Iris greenish-brown, bill black, feet fuscous.

Nest (April 30) in shrubbery in clearing two feet up, a bulky compact cup set on a light base of sticks, made of strips of banana leaves and plant bark and lined with brown rootlets and vine tendrils. Eggs two, nearly fresh, blue with a few spots of black in a wreath near the larger end, .72 x 1.03 and .75 x 1.01 ins.

A common species in thickets adjoining the forest; very quiet.

**335.** *Saltator atriceps lacertosus* Bangs. Panama Black-headed Saltator.

Female, Agua Clara, March 12, 1911. Iris brown, bill black, feet grayish-horn color.

A fairly common species. Has a loud and peculiarly harsh call.

Nest (April 30) three feet up in a shrub grown over with vines, a rather small open cup. Eggs two, bluish-green wreathed with black at the larger end, 1.13 x .76 and 1.12 x .79 ins. Another nest in same sort of situation (March 24, 1912), made of weed stalks and tendrils, contained two fresh eggs, 1.07 x .76 and 1.06 x .75 ins.

**336.** *Saltator albicollis isthmicus* (Selater). Panama Streaked Saltator.

A male, Pedro Miguel, May 5, 1912, and female, Tabernilla, April 18, 1911. Iris gray-brown, bill black, feet pale brown.

[337.] *Astragalinus psaltria croceus* (Jouy). Central American Goldfinch.

**338.** *Spiza americana* (Gmelin). Dickcissel.

Male and two unsexed specimens, Gatun, June 16, March 16 and February 18, 1912; male, Miraflores, March 5, 1911, and female, Mindi, October 15, 1911.

March 16, a flock was seen along the river bank; the others were alone.

**339.** *Arremonops conirostris conirostris* (Bonaparte). Lafresnaye's Sparrow.

Male, Gatun, April 18, 1911; female, Ft. Lorenzo, June 11, 1911. Iris light brown, bill black lighter below, feet gray-brown.

Nest (April 18) in a tussock of grass against a stump about a foot from the ground, an open cup of dead leaves, strips of bark and weed stalks lined with light-brown rootlets. Eggs two, plain white, .71 x .93 and .72 x .93 in. Two other nests (June 2 and June 11) were

found, but of same materials, one in a shrub six feet from the ground. Eggs, two in each, were fresh; those in the latter one were larger, 1.06 x .72 and 1.05 x .74 ins.

**390. *Arremon aurantifrons* Lafresnaye.** Orange-billed Sparrow.

Male, Gatun, August 27, 1911. Iris brown, bill salmon-red, feet pale brown.

Found in the forest.

#### OCEREBIDÆ.

**391. *Coereba mexicana* (Scater).** Mexican Banana-quilt.

Three males, Gatun, April 4, June 25 and November 3, 1911. Iris brown, bill and feet black.

In thickets and second growth.

**392. *Dacnis cayana ultramarina* (Lawrence).** Ultramarine Dacnis.

Two males and two females, Gatun, June 4, November 26, 1911, and July 2, 1911, April 7, 1912. Iris reddish-brown, bill dull black above paler below, feet light brown.

Found in the jungle as well as in groves.

**393. *Cyanerpes cyaneus* (Linnaeus).** Blue Honey-Creeper.

Two males and a female, Gatun, July 2, 1911, April 14, 1912, and December 24, 1911. Iris brown, bill black, feet red.

Common in second growth.

**[394.] *Cyanerpes lucidus* (Scater and Salvin).** Shining Honey-Creeper.

**395. *Chlorophanes spiza guatemalensis* (Scater).** Northern Green Honey-Creeper.

Female, Gatun, June 4, 1911. Iris brown, bill black lighter below, feet bluish-gray.

#### TANAGRIDÆ.

**396. *Tanagra crassirostris* (Scater).** Thick-billed Euphonia.

Two males, Gatun, November 3, 1911, and April 4, 1912; male and female, Mindi, October 22 and September 17, 1911; male, Toro Point, March 3, 1912, and male, Mt. Hope, June 1, 1913. Iris brown, maxilla black with a bluish spot on each side, mandible bluish-gray, feet dark gray.

Seen frequently in second growth and in trees in open ground.

**[397.] *Tanagra fulvicauda* (Scater).** Fulvous-vented Euphonia.

**[398.] *Tanagra luteicapilla* (Cabanis).** Yellow-crowned Euphonia.

**[399.] *Tanagra minuta humilis* (Cabanis).** White-vented Euphonia.

**400. *Tangara larvata fanny* (Lafresnaye).** Mrs. Wilson's Tanager.

Male, Mindi, October 15, 1911, and female, Gatun, April 30, 1911. Iris brown, bill black, feet blue-black.

Usually seen on the edge of the jungle.

**401. *Tangara inornata* (Gould). Plain-colored Tanager.**

Male and female, Gatun, April 7, 1912, and May 30, 1911. Iris brown, bill black blue-gray below, feet blue-gray.

Found on the edge of the jungle.

**[402.] *Tangara gyroloides* (Lafresnaye). Blue-rumped Green Tanager.**

**[403.] *Tangara lavinia* (Cassin). Lavinia's Tanager.**

**404. *Thraupis cana cana* (Swainson). Blue Tanager.**

Two females, Toro Point, April 2, 1911, and also taken at Gatun, March 2, 1911. Iris brown, bill black above blue-gray below, feet dark grayish-blue.

A fairly abundant bird in thickets and cocoanut groves.

**405. *Thraupis palmarum melanoptera* (Selater). Black-winged Tanager.**

Three males, Gatun, March 2, 1913; Toro Point, July 23, 1911, and Ft. Lorenzo, January 7, 1912.

Found in cocoanut groves.

**[406.] *Ramphocelus luciani* Lafresnaye. Bonaparte's Tanager.**

**407. *Ramphocelus icteronotus* Bonaparte. Yellow-rumped Tanager.**

Male and female, Gatun, February 12, and a female, Gatun, April 30, 1911. Iris reddish-brown, bill light blue with dark edges and tip, feet dark blue.

Common in thickets along the edge of the jungle.

Nest five feet up in clump of shrubbery, a very compact cup, made of vines on the outside, dead leaves, plant fibers and finally a lining of brown and black rootlets. Eggs two, nearly fresh (April 30), blue with heavy blackish blotches on large end forming a cap, .67 x .93 in. Another nest (May 14) exactly the same, with the same sort of vine wrapped around the outside. Eggs two, fresh, .73 x .95 in., blue, with black spots more scattered.

**408. *Ramphocelus dimidiatus isthmicus* Ridgway. Panama Crimson-backed Tanager.**

Three males, Mindi, September 17, 1911; Tabernilla, March 19, 1911, and Gatun, April 5, 1912; two females Ft. Lorenzo, June 21, 1911, and Miraflores, March 5, 1911. Iris reddish-brown, bill black above, mandible white for basal two-thirds (uniform dusky in female), feet black.

A fairly common species in thickets.

Nest a frail shallow cup, made of strips of plant bark and dead leaves, lined with finer grass stalks and a few black hairs, ten feet up in a bush. Eggs two (June 11), blue, with irregular spots and scrawls of black about the larger end; one much more extensively spotted than the other, .96 x .66 and .96 x .69 in. Another nest (March 3, 1912) at Toro Point contained two fresh eggs, .94 x .70 in.

\*[409.] *Piranga rubra rubra* (Linnaeus). Summer Tanager.

\*[410.] *Piranga erythromelas* (Vieillot). Scarlet Tanager.

411. *Phoenicotherapia fuscicauda* Cabanis. Dusky-tailed Ant-Tanager.

Two males, Gatun, May 30, 1911, and January 21, 1912; two others, Agua Clara, March 12, 1911, and Mt. Hope, June 1, 1913; two females, Gatun, May 14, 1911, and Agua Clara, March 12, 1911. Iris brown, bill black (brown in female), feet gray suffused with pink.

Found in thickets and in the jungle. It has a guttural scolding note somewhat similar to that of a wren but with more volume.

Nest in a cluster of orchids on a vine eight feet up; a cup made of dead leaves wound tightly with green vines and lined with brown rootlets. Two fresh eggs (May 14), glossy white, .66 x 1.01 and .65 x .95 ins.

Stomach of one of the birds contained many insects, a few seeds and a small snake.

[412.] *Heterospingus rubrifrons* (Lawrence). Lawrence's Tanager.

413. *Tachyphonus rufus* (Boddaert). Boddaert's Tanager.

Male and female, Tabernilla, April 8, 1911, and female, Gatun, May 7, 1911. Iris brown, bill and feet bluish.

Nest (May 7) in a clump of leaves of wild banana two feet from the ground. Eggs two, .70 x .94 and .71 x .96 in., gray spotted and scrawled with black very much like those of *Agelaius phoeniceus*.

414. *Tachyphonus luctuosus* Lafresnaye and D'Orbigny. White-shouldered Tanager.

Male, Gatun, February 11, 1912. Iris grayish-brown, bill black with wedge-shaped blue spot on the sides, tarsi blackish-slate.

[415.] *Tachyphonus delatrii* Lafresnaye. Tawny-crested Tanager.

416. *Eucometis cristata* (DuRoi). Gray-crested Tanager.

Two males, Gatun, February 5 and July 9, 1911, and an unsexed specimen, March 3, 1912. Iris reddish-brown, bill black, feet flesh color.

Found in thick undergrowth of jungle.

Nest a loosely built cup, formed entirely of slender round fibers and very fine reddish-brown tendrils, situated in a bush. Two eggs, partly incubated (July 9), gray, heavily marked with blotches and smears of smoky-brown and blackish, .94 x .70 and .92 x .69 in.

[417.] *Mitrospingus cassini* Lawrence. Cassin's Tanager.

418. *Rhodinocichla rosea eximia* Ridgway. Panama Thrush Tanager.

Two males, Tabernilla, March 19, 1911, and Pedro Miguel, May 5, 1912; female, Mt. Hope, February 20, 1913. Iris light brown, bill blue-gray dusky at base, feet bluish-black.

Found in thickets. Song very striking; a loud clear whistle of two

notes or syllables, repeated several times. More often two birds near together sing at the same time, but in a different pitch, as if one song was an accompaniment to the other.

I follow Dr. Hubert Lyman Clark in placing this bird in the Tanagridæ and have altered Mr. Ridgway's vernacular name "Thrush Warbler" as suggested by Dr. Clark (cf. *The Auk*, 1913, p. 11).

#### IOTERIDÆ.

[419.] *Zarhynchus wagleri wagleri* (Gray). Wagler's Oropendula.

[420.] *Gymnostinops montesuma* (Lesson). Montesuma Oropendula.

[421.] *Cacicus microrhynchus* (Sclater and Salvin). Small-billed Cacique.

422. *Cacicus vitellinus* Lawrence. Lawrence's Cacique.

Male, near Agua Clara on the Trinidad River, March 12, 1911. Iris bright blue, bill light lemon-yellow, feet black.

One of a flock that were building nests in a fair-sized tree on the river bank. Many nests were under way, but none advanced enough to judge of their size.

423. *Cassidix orizivora violacea* Bangs. Colombian Rice Grackle.

Female, Gatun Lake, July 16, 1911. Iris buffy-yellow, bill and feet black.

Shot from a tree top; was alone.

\*[424.] *Dolichonyx oryzivorus* (Linnaeus). Bobolink.

425. *Amblycercus holosericeus* (Lichtenstein). Prevost's Cacique.

Female, Gatun, February 5, 1911. Iris very light yellowish-brown, bill light greenish-yellow, feet bluish-gray.

An inhabitant of the jungle.

[426.] *Leistes militaris* (Linnaeus). Red-breasted Blackbird.

\*[427.] *Icterus spurius* (Linnaeus). Orchard Oriole.

\*[428.] *Icterus galbula* (Linnaeus). Baltimore Oriole.

[429.] *Icterus gairaudii* Cassin. Gairaud's Oriole.

430. *Icterus mesomelas salvinii* (Cassin). Salvin's Oriole.

Three males, Gatun, February 18 (2) and 22, 1912; two females, Gatun, May 14 and 28, 1911, and a male, Toro Point, August 4, 1912. Iris brown, bill bluish-gray darker on culmen, feet grayish-blue.

Found in wild banana thickets and in trees.

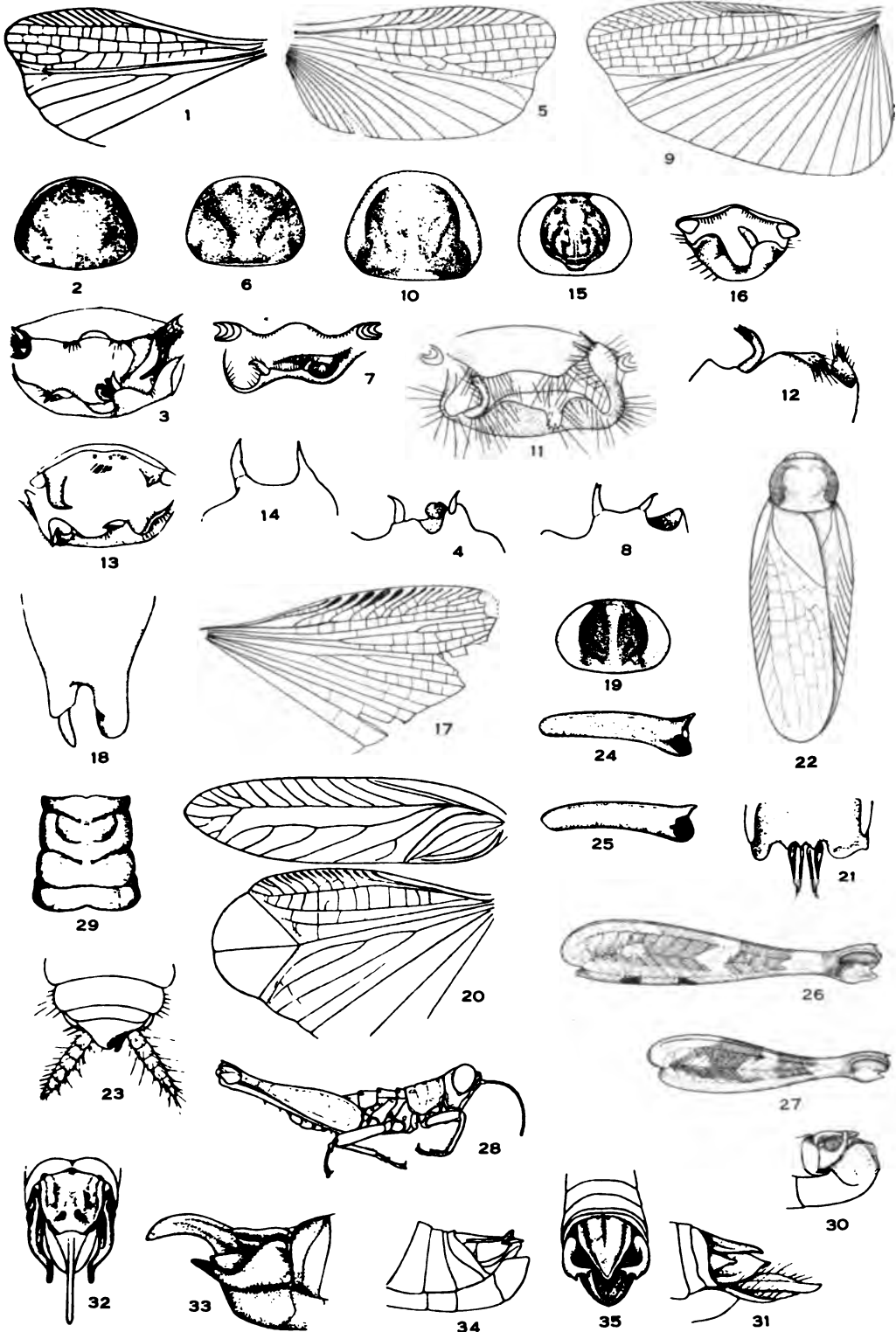
[431.] *Megaquiscalus major macrourus* (Swainson). Great-tailed Grackle.

#### CORVIDÆ.

432. *Cyanocorax affinis seledoni* Ridgway. Talamanca Jay.

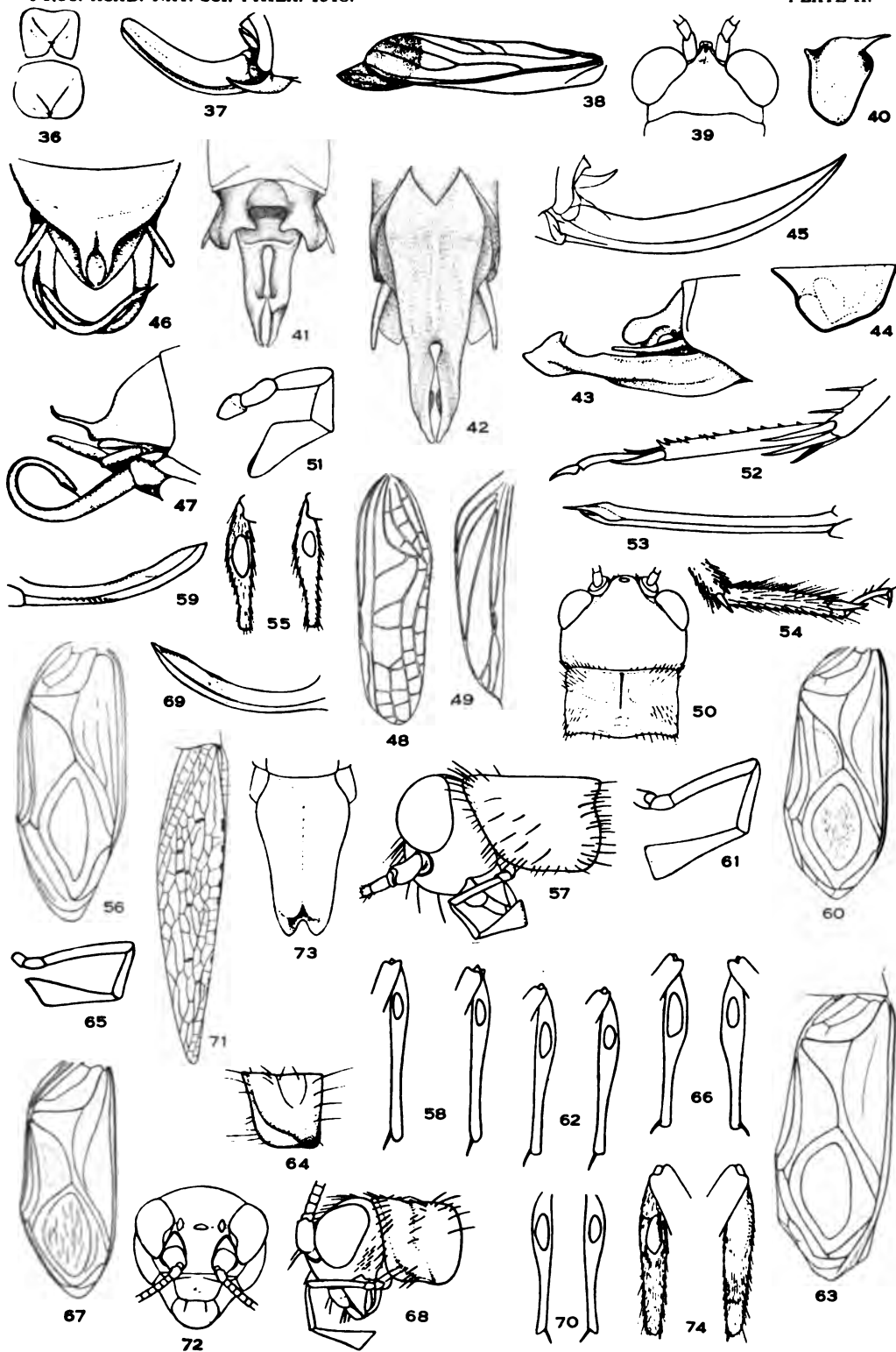
Male, Gatun, January 1, 1912; another not in the collection was secured August 13, 1911, at the same place.

Found in the forest in small flocks, shy and hard to approach.



REHN. ORTHOPTERA FROM PARÁ.





REHN ORTHOPTERA FROM PARÁ.





## NOVEMBER 19.

THOMAS H. FENTON, M. D., in the Chair.

Twenty-seven persons present.

The Publication Committee reported the presentation of papers under the following titles for publication in the PROCEEDINGS:—

“On the generic position of *Sonorella wolcottiana*,” by H. A. Pilsbry (April 30, 1918).

“A new Characin from Paraguay,” by Henry W. Fowler (May 2, 1918).

“Two New Shells from Haiti,” by E. G. Vanatta (July 1, 1918).

“Birds of the Panama Canal Zone, with special reference to a collection made by Mr. Lindsey L. Jewel,” by Witmer Stone (October 10, 1918).

“Mollusca of the Southwestern States. IX, The Santa Catalina, Rincon, Tortillita and Galiuro Mountains. X, The Mountains of the Gila Headwaters,” by Henry A. Pilsbry and James H. Ferriss (November 8, 1918).

A paper entitled “The Northeastern Florida Coast Revisited,” by Clarence B. Moore, was presented May 6, 1918, for publication in the JOURNAL, completing the sixteenth volume of the second series.

The deaths of the following members were announced:—

Frank Miles Day,  
William F. Dreer,  
Theodore H. Conderman,  
Isaac Norris, M. D.,  
William F. DuBois.

The following was ordered to be published:

**MOLLUSCA OF THE SOUTHWESTERN STATES—IX, THE SANTA CATALINA, RINCON, TORTILLITA AND GALIURO MOUNTAINS. X, THE MOUNTAINS OF THE GILA HEADWATERS.**

BY HENRY A. PILSBRY AND JAS. H. FERRISS.<sup>1</sup>

The Santa Catalina, in Pima County, north of Tucson, is one of the large ranges of Southern Arizona, about forty-five miles in length, including its Tanque Verde and Rincon outliers, with an extreme width of twenty-five miles. Mount Lemon with an elevation of 9,150 feet is heavily forested with yellow pine, quaking asp, cork bark fir (*Abies arizonica*), Douglas spruce (*Pseudotsuga mucronata*), cypress (*Cupressus arizonica*), other coniferous trees, large oaks and an alder as tall as a pine. The male fern and the brake stand here four feet in height. The Douglas spruce are eight feet in diameter. There is a forest gloom at mid-day, and a ground covering indicating a timber growth of many years without interruption by fires or lumbering. Winter often brings ten feet of snow. With numerous trout streams, it has the attractions, summer and winter, of the deep forests along the Canadian border without their annoying insects.

In quantity and number of species of the smaller snails the north slope of Mount Lemon has the best record so far. The odor-shooting, rough-coated *Sonorella* also is here in large numbers under the fallen bark of the Douglas spruce and the dead poles of the quaking asp and cork bark fir. Unlike his brethren with a polished coat, this snail seeks food and cover similar to those used by the *Polygyras* of timbered areas in the Mississippi valley and eastward.

The humid forest conditions of the region around Lemon Mountain prevail at Soldier Camp, Kellogg's Peak, Alder Canyon, Alder Springs. The Spud Rock Ranger Station and other high peaks of the Rincon section, except in lacking cork bark fir, also follow Mount Lemon closely in forest conditions. They have the large oaks and conifers, the quaking asp, and the heavy floor of humus underfoot, but not quite as many snails.

In the valleys of Bear Wallow and Sabino creeks, at the heart of the Santa Catalinas, the Arizonians of lower and hotter levels have

<sup>1</sup> The field work covered by this report was by Ferriss, assisted in the Blue River region and the Mogollon Mountains by the late L. E. Daniels.

built villages of summer cottages. It is about a full day's journey from Tucson on horseback. A small saw mill furnishes building material for this summer society, for a sanitarium now under construction and for the copper mines over the ridge at the foot of Marble Peak.

Except in the valley of the San Pedro river and the village of Oracle only a few miners, ranch men and forest rangers are to be found in all this group of ranges. There are more bears and mountain lions than people.

The southern slopes of the Catalinas, the foot hills and mesas, and the Galiuro and Tortillita ranges are not heavily forested. At best it is low, open woods or desert shrubbery, through which the granite rocks and precipices glisten in the sun. The soil is dry, though often covered with fallen leaves and growing vegetation. A few Sonorellas and some of the smaller snails may be found at all altitudes in the rock slides, the talus, on all sides of the mountain, and in any kind of rock, especially smooth and stratified rock; sometimes also under fallen timber, or in small piles of boulders.

In the dry season, among dry and hot rocks, dead shells will be the rule. Here one must dig a full eight hour day for a live one. We find a two-foot bar of half inch octagonal steel very helpful. The bar should have a two-inch chisel edge flattened out at each end, one of these turned at a right angle like a hoe. It will weigh one and three-quarter pounds; a good digger, a jimmy for rock work, and a helpful staff in steep and rough places.

*Sonorella* is something of a rambler, more so than *Ashmunella* or *Oreohelix*, and upon damp days scouts may be met out in the fallen leaves far from their rocky homes. Often single, dead, lie along the trails where there is no shelter in the vicinity for snail kind. In 1913, on the south side of the Santa Catalinas in the dry season, day after day but one or two living Sonorellas were found. It was the same about Brush Corral Ranger Station, on the north side, in the rocky slides of the canyons nearly on a level with the river. In one of these slides of three or more feet in depth, three hundred good "bones" were found but none alive. It was also the same kind of collecting in the Galiuros and the Tortillitas in the winter of 1917-18.

A small deep slide of "porphyry" or shale, shaded partially with rose bushes, elder or gooseberry bushes, makes an ideal home for the Southwestern snails.

The Galiuro range, in Graham County, and the Tortillita range, in Pinal County, as yet unsurveyed, seem to have an elevation of

about 7,000 or 8,000 feet, granite or other igneous rock prevailing, and with but a little timber. A few ledges of sharp-pointed limestone, dolomite probably, had no attraction for the snails. The entire region at present is inaccessible except to horsemen and pedestrians and these should carry their own food and shelter. We did, and lived like kings before the war.

One of us (Ferriss) collected a few days, less than a week, in the Santa Catalinas, Mount Lemon and Soldier Camp, in 1910; again much of the time from May to October in 1913, on the southern slope, around Mount Lemon, Soldier Camp, Marble Peak and on the northern mesa, about Brush Corral. Again a month was spent in 1917, at Sabino Basin, Bear Creek, and Brush Corral, the Rincon Peaks and the Galiuros. The guide, Frank Cole, on a hunting trip, brought in *Sonorellas* from the Tortillitas and from the Cañada del Oro section of the Santa Catalinas. Many inviting prospects in these mountains remain neglected. They surely contain species still unknown.

Life is rapid in snaildom, decay a slow process in an arid climate; and possibly these fat cemeteries in the basements of *Sonorella* slides merely represent the natural death rate of many years. It may be that one living inhabitant to one hundred skeletons is the right proportion. However an impression grows upon the collector as he digs in the arid foothills, that in earlier times there were periods or seasons more favorable to snail life—seasons with more moisture, more vegetation, and a deeper humus. The steep mountain gulches with walls on either side thrown above the surrounding surface quite plainly speak of days when the floods were greater than any known in modern times. These boulder bulwarks contain potsherds and other evidence of human occupation; also *Sonorellas*. As collecting grounds they are often preferable to the large slides farther up the mountain. Among these boulders, in the hot sunlight, we found the largest *Sonorella*. Measured crudely in the field it had a diameter of 33 millimeters.

In collecting *Sonorellas* and *Oreohelices* from arid to humid zones in the same canyon or mountain, one gets the impression that the differences of size are mainly a matter of the breed; that they are racial, rather than due to length of growing season, supply of food or climatic comforts. We naturally search ideal environments of food, shade and shelter for robust races, and expect to meet the pigmy forms in hot, dry and barren places. Often what we find is the reverse of this. On one climb in 1918, at Kitt's Peak, a large

and robust *Sonorella* was found at a low elevation in a barrier of boulders, so dry and barren the snails would necessarily lie dormant a large part of the year. At a thousand feet higher, beside a stream of running water, came in a much smaller breed; and, 1500 feet above number two, with an ideal situation as to a moist atmosphere, food, shelter and snail comfort, lived a pigmy *Sonorella* of about 12 millimeters in diameter.

Again on the Kaibab Plateau in 1909, every colony of *Oreohelix strigosa depressa* seemed a little different from all other colonies. At Two Spring Canyon with running water all the way, the pigmies were at the higher station in a grove of quaking asp. Every colony increased in size and color brilliance at a regular pace down the canyon. Here seemed proof positive of the advantage of a longer growing season. Over the ridge in Snake Gulch the order was reversed, for the larger shells were at the top in a dry situation, and their size seemingly decreased in proportion to the mileage as we descended along a running stream. In Jacobs Canyon, running parallel to Snake Gulch, dry all the way, the large and gaudy shells were midway, the smaller and paler above and below. Food conditions may have had some influence in the development of these races but if so the evidence was not apparent. In the field we meet contradictions continually beyond our understanding, but perhaps we may have a better comprehension before the survey of the Southwest is completed.

#### HELICIDÆ.

*Sonorella odorata* n. sp. Pl. III, figs. 1 to 4.

The shell is depressed, umbilicate, the umbilicus contained about  $7\frac{1}{2}$  times in the diameter of shell; buffy-citrine below, somewhat lighter than isabella color above, with a chestnut brown band at the shoulder. The first half whorl has irregular radial wrinkles soon passing into a low granulation, the last embryonic whorl granular, over which there are close decurrent threads, interrupted into short dashes on the upper part of the whorl. Subsequent whorls are very minutely granular, somewhat dull, the granulation effaced at the base, which is more glossy. The last whorl shows also numerous faint spiral striae. The whorls are quite convex, the early ones increasing slowly, the last widening rapidly, rather abruptly descending close to the aperture. The aperture is elliptical-lunate; peristome is narrowly expanded throughout, dilated at the columellar insertion.

Alt. 11.4, diam. 19.5 mm.;  $4\frac{1}{2}$  whorls (type).

" 13.4, " 23.3 "  $4\frac{2}{3}$  " (Station 18, 1917).

" 13.2, " 22 " (Station 18, 1917).

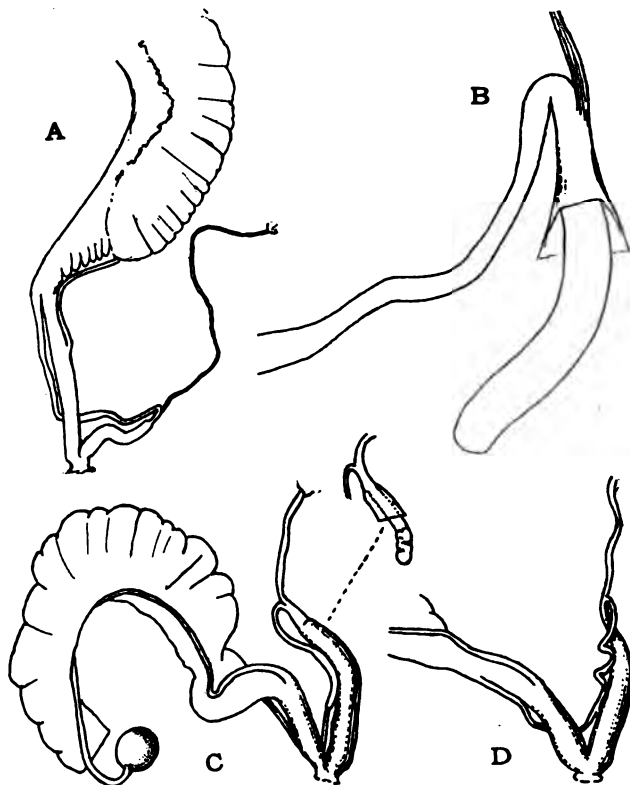


Fig. 1. Genitalia of *S. odorata*. a, No. 119,032; b, penis-papilla of same much enlarged; c, No. 119,035, with detail of penis-papilla; d, No. 119,034.

The sole is tripartite in color, the side areas being somewhat darker. The back and head are quite dark in most alcoholic specimens, black in life, the tips of the tubercles lighter.

The penis is small, containing a cylindric papilla with rounded end, about two-thirds as long as the penis. The penial retractor is inserted upon the epiphallus not far from its base. The flagellum is present as a very minute but distinct bud in most of the specimens opened, but in two it was not seen though looked for. In the specimen No. 119,032 (figs. 1a, b,), the male organs are evidently not fully developed, the penis and epiphallus being small and short, while the retractor muscle is correspondingly longer, making the total length about normal, the individual being of full size though not adult. Measurements of the organs in mm. follow:

LOCALITY.	Penis.	Penis- papilla.	Epiphallus.	Flagellum.	Penial retractor.	Vagina.	Spermatheca and duct.	Diameter of shell.	Number.
Head of Alder Canyon . . .	6.6	...	7.5	trace	7	6	...	20	119,033
" " " . . .	6.5	4	7.2	0	8.5	7	...	20	119,033
N.-E. side Mt. Lemon . . .	6	3.3	8	trace	5	4.5	...	19	119,034
" " " . . .	6	4	5	trace	7	4	...	24	119,035
" " " . . .	7	5	8	trace	6	5	...	...	119,035
S. of spring, Mt. Lemon <sup>2</sup> . .	3.5	2	3.2	0	13.5	5	...	20	119,032
<i>S. o. marmoris</i> , Station 36	10.7	6.5	8	dist.	...	8	...	20	109,071a

Santa Catalinas above 7500 ft.: Mt. Lemon, Stations 5 and 6 (1911), 32 and 37 (1913), on the trail to Webber's and other places. Soldier Camp, Bear Wallow, Head of Alder Canyon (type loc., No. 119,033). Kellogg Peak, southeastern side.

Rincones at station 22, Spud Rock Ranger Station, and Station 20, on the north slope.

It lives in deep humid forest in colonies, as our eastern helices do, under logs and bark of quaking asp and Arizona fir, sometimes by dozens. Only at Spud Rock it was found deep in rocks, also humid. It is a timber snail of the Canadian zone forest. In general aspect the shell reminds one of the Californian helices.

This is a common snail in the heavily wooded upper levels of the Santa Catalinas, taken at many stations. When picked up it emits a strong unpleasant odor recalling that of the goldenrod of Thunderhead mountain in East Tennessee (probably *Solidago odora*). This was first noticed at Kellogg Peak. When picked up the snail shot out two or three drops of liquid six inches or more (evidently expelled from the lung as the foot is retracted). One often smelled them before finding any. But three or four shells broken by mice or squirrels were noticed in the course of collecting, and it may be that the snail-eaters object to the smell.

By the genitalia this species is related to *S. clappi* of the Santa Rita range, and *S. ferrissi* of the Dragoons, though differing from both in several details. The shell is most like *S. clappi*. It differs from other Santa Catalina species by the minute granulation of the surface, which gives it a dull, silky luster.

The color is rather variable. At Soldier Camp (Fig. 4), Cañada

<sup>2</sup> Specimen not fully mature.



del Oro and some other places the general hue is cinnamon or cinnamon-buff, opaque, and the size small, diam. 18 to 20 mm. The smallest adult seen measures 17 mm. in diameter.

Specimens from the Rincons, Station 22 (1917), are pale cinnamon or greenish above, fading to a pale, bluish-gray on the base, the band with narrow, indistinct paler borders or without them. The lip is conspicuously brown-edged. The umbilicus is generally wider than in the Catalina shells. One perfect shell and another broken one in this lot are albinos, or at least the tint is very pale, and there is no band. These shells are found deep in a rock slide in a quaking asp thicket. At Station 20 (1917), on the northern slope of the Rincons, two dead but fresh shells were found in a day's search.

*Sonorella odorata marmoris* n. subsp. Pl. III., figs. 6 to 6b.

The shell is more solid than *S. odorata*, opaque; cinnamon, paler around the umbilicus and on both sides of the chestnut-brown band. Last whorl is decidedly more depressed than in *S. odorata*, and is narrower as viewed from above. The umbilicus is wider. The aperture is much smaller.

Alt. 10.4, diam. 20 mm.;  $4\frac{3}{4}$  whorls (type).

" 9, " 18 "  $4\frac{1}{2}$  " "



Fig. 2. Genitalia of *S. o. marmoris*, No. 109,079, with detail of penis-papilla.

Santa Catalina Mountains: Marble Peak, on the east side above the rock slide; old Dan's Gulch on the northwest side, type loc.; ridge running toward Mt. Lemon; Ferriss 1911 and 1913. Type No. 109,075 A. N. S. P.; paratypes 109,075a, also in Ferriss collection.

Genitalia (fig. 2) in general similar to *S. odorata* but the penis and papilla are decidedly longer and there is a flagellum, well developed for a *Sonorella*. Measurements of the organs are given in the table on page 287.

It lives in relatively dry rock slides, with the smooth *Sonorella marmorarius*, high on Marble Peak and its flanks, thus differing in habits from *S. odorata*. The shell is readily separable from *odorata*, and perhaps it should be considered a separate species. It has the same peculiar odor.

*Sonorella sabinoensis* n. sp. Pl. IV, figs. 1 to 5d.

The shell is rather narrowly umbilicate (width of umbilicus contained 8 times in that of shell in the type specimen), rather solid; cinnamon-buff, broadly zoned with white (or whitish) on both sides of the chestnut-brown band above the periphery. The surface is glossy; embryonic whorls having the usual sculpture of the *hachitana* group, granular, with divaricating protractive threads below and retractive above; subsequent whorls delicately marked with growth-lines. Suture descends moderately in front. The aperture is large, oblique, rotund-oval. Peristome narrowly expanded, dilated at the umbilical insertion.

Alt. 12, diam. 21.2 mm.; aperture 12x13 mm.;  $4\frac{1}{2}$  whorls.

Santa Catalina mountains, Arizona, in Sabino canyon (type loc. Station 16, 1913) and its tributaries, Sycamore canyon and Mt. Lemon Fork, from about 3000 to 6000 feet elevation. Also Rock and Vantana canyons, west of Sabino, and Bear canyon eastward.

It is a species of the dry, sun-baked rock-slides, living ones found only deep in the crevices, in the lower levels of desert vegetation. The Sabino Basin, Sycamore and Bear canyon localities are below the pine belt, in arid country, with some oak, juniper and sycamore. The species is not known to occur in the humid upper forest.

Genitalia (fig. 3, *a-d*) resembling those organs in *S. marmorarius*. The penis is thin, not swollen basally. The penis-papilla is slender and corrugated, as in the other species, and nearly as long as the penis (fig. 3a). The flagellum is either minute or wanting.

Mus. No.	Penis.	Papilla.	Epiphallus.	Flagellum.	Vagina.	
109,097	10	7	8	0	9	Type, fig. 3c.
109,092	9.5	8	7	0	7.3	
109,094	10.5	10	9	—1	9	Fig. 3d.
109,087	9	7	6	0.3	8.5	
109,098	8.5	8	6.5	0.5	6.5	Fig. 3a, b.

Shells from the type station measure from 20 to 24 mm. diameter. The relative size of the aperture also varies within rather wide limits. In the type specimen (pl. IV, figs. 2-2b) the width of aperture is con-

tained about 1.63 times in that of the shell, and in another locotype (pl. IV, figs. 3-3b) it is contained nearly 1.8 times. In the smaller mouthed individuals the umbilicus is somewhat larger and less covered, and the last whorl, viewed from above, is not so wide. We have tried in vain to use these characters for a separation of the series (some hundreds of shells); but while the extremes in size of aperture appear quite distinct, the distinction could not be carried through, as nearly every station supplied individuals with large, intermediate and small apertures.

The specimens from low in Sabino canyon usually have more solid, thicker shells than those from higher; but this is not always the case.

It is a species of the arid mountains, confined to lower elevations than *S. marmorarius*.

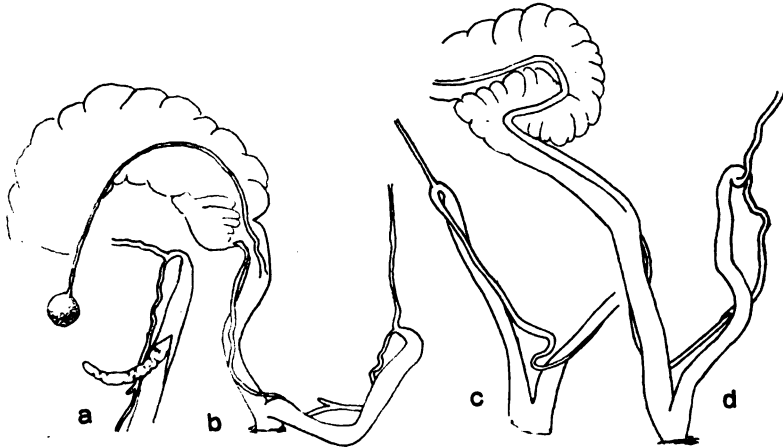


Fig. 3. *Sonorella sabinoensis*, Sabino Canyon, genitalia. a, b, No. 109,098; c, No. 109,097; d, No. 109,094.

The smallest shells, diam. 19 mm., were found at Station 15, low in Sabino canyon (about 4,000 ft.); but others up to 25 mm. diam. occur in the same place. The largest, 27 mm. diam. are from Station 9, 1913, the bluffs opposite Station 15. One of this lot is figured, pl. IV, figs. 4-4b.

The degree of depression is variable in the same lot. Specimens selected from a station on Vantana canyon measure:

Alt.	14.5	diam.	26,	mm.	(largest).
"	13.2	"	25,	"	(most depressed).
"	16.4	"	24.8,	"	( " elevated).
"	12.2	"	20,	"	(smallest).

Figures 5 to 5d are depressed and elevated shells from Bear canyon.

*Sonorella sabinoensis occidentalis* n. subsp. Pl. V, figs. 1 to 1b.

The shell appears indistinguishable from *S. sabinoensis*.

Alt. 16, diam. 28 mm.; 5 whorls.

" 17.3 " 27 " 5 "

" 16 " 25 "

" 14 " 23.7 "  $4\frac{1}{2}$  "

" 14 " 22.3 "  $4\frac{1}{2}$  "

This form is separated from *S. sabinoensis* solely on account of the difference in the penis, which is enlarged at the base in *occidentalis*, slender in *sabinoensis*. While the Pima canyon shells are distinguishable from the large-mouthed typical forms of *sabinoensis*, we can find no difference in the *sabinoensis* with slightly smaller aperture, such as those from Sabino canyon Station 9 (which agree in genitalia with the type of *sabinoensis*). No specimens with the penis swollen basally were found among the numerous Sabino canyon individuals opened.

The head and back are hair brown, fading to drab on the sides, the tail and entire sole being dull chamois to dull cream-buff.

Western end of the Santa Catalinas; type No. 119,491, from Station 36, east side of Pima canyon. Also on the west side, Station 37 (Pusch Ridge); Station 43 (1917), northeast of Sutherland's ranch, in the foothills; Station 45, in the large canyon north of Romero canyon (eastward from Sutherland's).

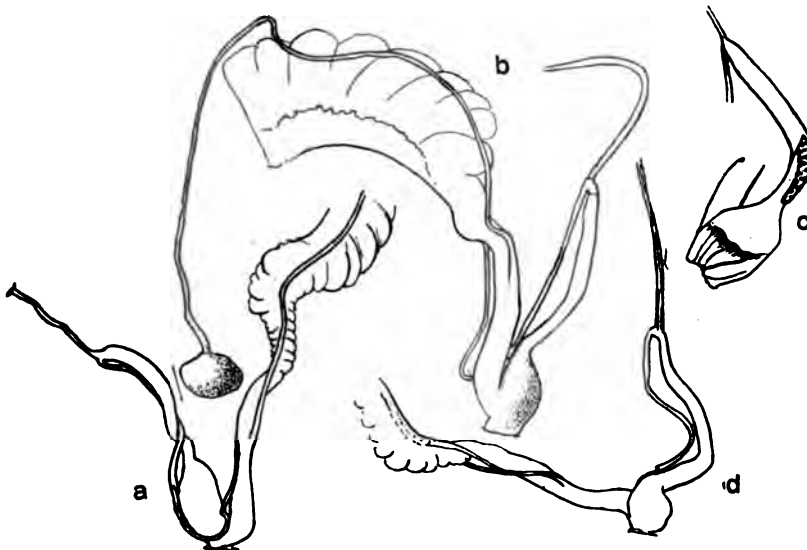


Fig. 4. Genitalia of *S. s. occidentalis*. a, No. 118,052. b, No. 118,045, with detail of penis and papilla at c; d, No. 118,056, canyon north of Romero Canyon.

Genitalia (Fig. 4a-d). The penis is slender except at the base where it is suddenly dilated. Internally there is a short, sinuous fleshy fold and several minor folds in the dilated part of the penis where it passes into the atrium, which also contains several fleshy ridges. The papilla is long, slender and corrugated. Penial retractor is terminal and enveloping base of the epiphallus, as usual. The epiphallus is nearly as long as penis, with a slight distal swelling in place of a flagellum. The vagina is shorter than the penis. Measurements of the organs in mm. follow:

Mus. No.	Penis.	Papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.	Locality.
118,045	10	8	8	0	6	32	Sta. 36.
118,052	8.5	6	7.5	minute	4	23	Sta. 37.
118,056	9	6.5	7.5	"	6	"	45.

The series of 60 specimens from Pima canyon consist chiefly of dead shells. The average size appears to be slightly less in the specimens from the western side of the canyon, forming the eastern slope of Pusch Ridge.

There are three "dead" specimens from "Pusa Ridge" (? = Pusch Ridge) in the U. S. National Museum, No. 271,011, collected by Barber. The diameter is about 22 mm.

The specimens from the canyon north of Romero (opening northwestward), Station 45 (1917), have the same range of variation noted in Sabino canyon *S. sabinoensis*. There are depressed, more openly umbilicate shells, together with smaller, usually less depressed shells with relatively larger aperture and smaller umbilicus,  $\frac{1}{3}$  to  $\frac{1}{2}$  covered by the expansion of the columellar lip; also a few specimens transitional in these characters. 14 examined.

Alt. 15.4, diam. 27.3 mm.,  $4\frac{3}{4}$  whorls (largest).

" 15.6, " 23 "  $4\frac{1}{2}$  "

" 14.3 " 22 " (smallest).

The genitalia do not differ from Pima canyon shells.

Seven shells from Station 43 (1917) measure: diam. 21, 21.5, 23.5, 23.7, 24, 24.4, 24.4 mm.

All of the localities for this form are in the arid lower zone of the range.

*Sonorella sabinoensis buelmanensis* n. subsp. Pl. V, figs. 2 to 3b.

Typically the shell differs from *S. sabinoensis* by being more solid and more elevated, only very slightly paler near the shoulder band, and with-nearly one whorl more in examples of the same diameter.

Alt. 16.7, diam. 25.6 mm.;  $5\frac{1}{2}$  whorls (type; Figs. 2-2b).

" 17, " 25.2 "  $5\frac{1}{2}$  " (topotype).

" 15.7 " 23 "  $5+$  " ( " ).

" 17.7 " 25.8 " 5 " (Sta. 43).

" 13.7 " 21.5 "  $4\frac{3}{4}$  " ( " " ).

" 13 " 21 "  $4\frac{3}{4}$  " ( " " ).

Buehman canyon, in the eastern part of the Santa Catalina Mountains, the type from Station 44 (1913), near the Korn Kobb mine. Also at Stations 41, head of Sycamore gulch, tributary to Buehman canyon, 42, Buehman canyon at the Brush Corral, and station 43, Buehman canyon a mile below the Brush Corral Ranger Station.

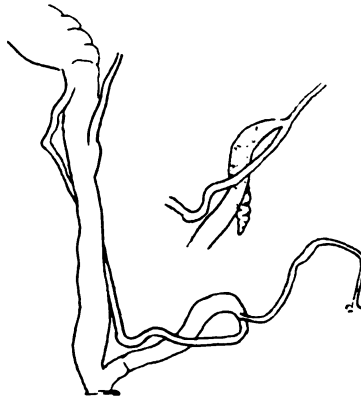


Fig. 5. Genitalia of *Sonorella sabinoensis buehmanensis*, No. 109,196.

There is considerable variation in the shells from Buehman canyon, in size, degree of elevation and number of whorls; yet unless anatomical differences are found, we consider them all of one race. As yet, only the typical form has been dissected.

Specimens from Station 41 (1913), from the head of Sycamore Gulch, have the umbilicus slightly more open than in typical *buehmanensis*, and the borders of the shoulder-band are paler; thus approaching the larger forms of *S. sabinoensis*.

In Stations 42 and 43 the size varies widely, and the smaller specimens have only a fraction of a whorl more than *sabinoensis*, from which they differ by the smaller aperture. One figured (pl. V, figs. 3-3b, Station 43) measures: alt. 13.7, diam. 21 mm. In the same lots the larger shells have a diameter of 25 mm. or slightly more.

Like other species of the dry lower mountains, living snails are rare. In one rock slide in Buehman Canyon, 360 fairly good "bones" were found, and only 8 living snails.

*Sonorella hesternus* n. sp. Pl. IV, figs. 6, 6a, 6b.

A long series of dead shells was taken at Station 148 (1917) in a rock slide on the south side of the Tucson-Benson highway, near the cave on Shaw's ranch, southern foothills of the Rincons, at about 3,500 feet. They are smaller and more solid than *S. rinconensis*, and the umbilicus is somewhat smaller. It is more depressed and has a wider umbilicus than *S. sabinoensis*. In color and surface it resembles the latter species. The freshest shells are between cinnamon and tawny-olive, fading around the umbilicus, white on both sides of the chestnut-brown band. The suture descends rather abruptly to the aperture, but not quite so deeply as in *S. hachilana*.

Alt. 13.5, diam. 22.4 mm. (type).

" 14.7, " 25.9 "

In a series of 37 adult examples, the smallest measures 20.1 mm. in diameter, the largest 25.9 mm. They run as follows:

Diam. 20-20.9 mm., 4 specimens.

" 21-21.9 " 11 "

" 22-22.9 " 7 "

" 23-23.9 " 9 "

" 24-24.9 " 4 "

" 25-25.9 " 2 "

The station is an extremely arid one. It is a true desert *Sonorella*. The status of the form is uncertain, but it can scarcely be linked with any of the Santa Catalina or Rincon species, so that, while we do not like to describe a *Sonorella* without examination of the soft anatomy, there seems nothing else to do in this case. Its status may be revised when living examples come to hand.

*Sonorella marmorarius* n. sp. Pl. III, figs. 9, 9a, 9b.

The shell is depressed, rather solid, umbilicate (the width of umbilicus contained about 7 times in that of the shell, suddenly widening at the last whorl to about double its former width); light pinkish cinnamon, paler around the umbilicus, and whitish on both sides of the chestnut-brown band above the periphery. The surface is glossy. Embryonic shell of  $1\frac{1}{2}$  whorls, the last of which is densely, irregularly granular, with indistinct protractive and retractive threads (when unworn), subsequent whorls delicately marked with growth-lines, and under the lens showing some weak spiral impressed lines in places on the upper surface of the last whorl. The suture descends rather deeply in front. Aperture is quite oblique, oval. Peristome expanded throughout, with a gray edge, somewhat thickened within, the margins generally connected by a roughened callous ridge in fully adult shells.

Alt. 14 diam. 25 mm.; aperture 11.2x13.6 mm.;  $4\frac{3}{4}$  whorls.

Marble Peak, Santa Catalina Mountains, Arizona; type loc. Station 26, 1913, quartzite slide on Marble Peak. Also found at Station 3, 1911, slide above Apache mine; Station 4, 1911, top of ridge south of the Peak; Station 38, 1913, north side of Marble Peak; "Joliet Cave," and other stations on the same mountain.

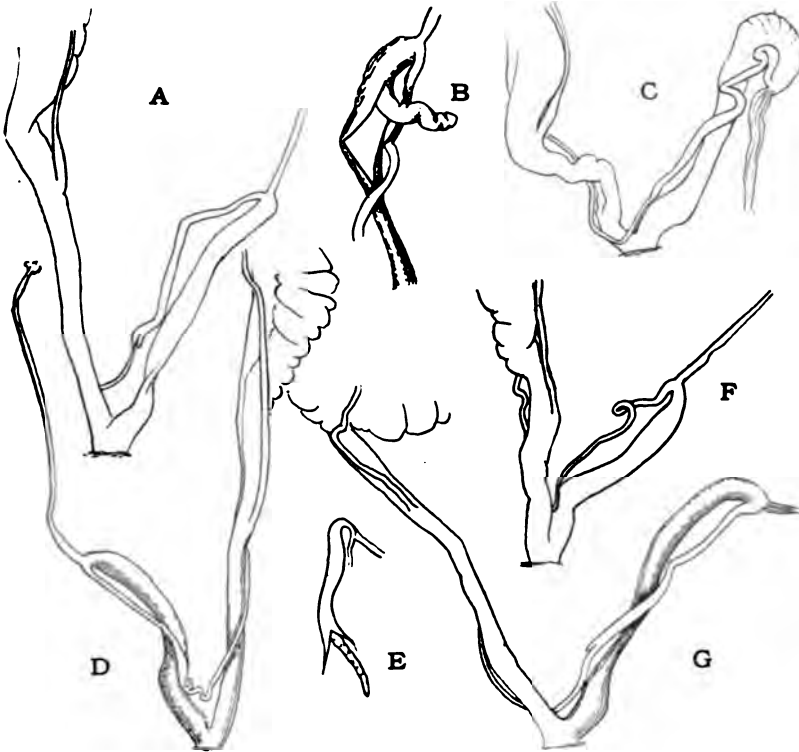


Fig. 6. Genitalia of *Sonorella marmorarius*, a, No. 109,077; b, c, No. 109,071; d, No. 109,039; e, No. 109,083; f, No. 109,084; g, No. 109,078.

Genitalia (Fig. 6a-g). The penis is thin-walled, very weakly or usually not noticeably enlarged near the atrium, containing a slender tapering, corrugated papilla, half to two-thirds or more the length of penis. Epiphallus somewhat shorter than penis, typically terminating in a little flagellum, but this is often rudimentary or wanting. Penial retractor long, inserted on apex of penis and base of epiphallus. The vagina is but little shorter than the penis. Lengths of the organs in mm. follow, the specimens all from stations on Marble Peak:



Mus. No.	Penis.	Papilla.	Epiphallus.	Flagellum.	Retractor.	Vagina.	Station.	Fig.
109,078	12.5	7.3	8	—1	.....	10	26	6g.
109,077	12.	8	10	1	8	11	26	6a.
119,039	9	6	7.3	1	12	8.5	4(1911).	6d.
119,040	10	8.5	7	0.5	.....	9.5	3(1911).	.....
109,074	11.5	10	9	1	.....	9	.....	.....
109,083	8.5	7	.....	0.5	.....	7	22	6e.
109,084	9	7	.....	0	11	5.5	.....	6f.
109,080	12.5	6	.....	0	.....	7	38	.....
109,071	11.5	6	7.3	0	.....	6	Cave	6h, c.

This species is closely related to *S. hachitana* (Dall) and *S. compar* Pils. It has the peristome more thickened within than the former and differs from *S. compar*<sup>3</sup> by the more solid shell, more thickened peristome, etc.

The more widely open umbilicus distinguishes it readily from other *Sonorellas* of the *hachitana* group found in the Santa Catalinas.

Other specimens of the original lot from the type locality measure:

Alt. 15 diam. 26.3 mm. Alt. 13.8, diam. 24 mm.

" 15.3 " 24.6 " " " " 23 "

" 13 " 23.6 " " 12.5, " 22 "

The largest examples were taken at Station 3, two measuring:

Alt. 16.4, diam. 28.2 mm.; 5 whorls.

" 17 " 28 " 5 "

Marble Peak and Apache Camp have oak, juniper and sycamore wood on the lower slopes; the crest of the ridge, the head of the main "slide," is in the pine belt.

*Sonorella marmorarius limifontis* n. subsp. Pl. III, figs. 5, 5a, 5b.

The shell is depressed, openly umbilicate (the width of umbilicus contained 7 times in that of the shell); whitish, faintly buff near the suture and on the spire, having the usual chestnut-brown band. Last whorl wide, very deeply descending in front. Surface glossy, weakly marked with growth-lines as in related species of the *hachitana* group, and showing weak traces of impressed spiral lines on the upper surface of the last whorl. The last whorl descends deeply and abruptly in front. The aperture is very oblique, rounded-oval. Peristome somewhat expanded, slightly thickened within.

<sup>3</sup> *Sonorella compar*, new name for *Sonorella ashmuni* Pils., Proc. A. N. S. Phila. 1905, p. 259, pl. 17, figs. 9-14. Not *S. ashmuni* Bartsch.

On comparison with the type of *S. ashmuni*, this species is seen to differ conspicuously by the more depressed and more openly umbilicate shell.—H.A.P.

Alt. 13.3, diam. 22.3 mm.; 5 whorls.

" 14 " 23 " scarcely 5 whorls.

" 16 " 26.5 " 5 whorls.

Santa Catalina Mountains at Station 17, bluffs near Mud Springs, on Pine Canyon.

The last whorl descends more than in *S. marmorarius*, the aperture is more oblique, and the color of adults is paler. The immature shells have more of a cinnamon tint than the adults.

The spiral lines mentioned in the description are usually very faint, often scarcely discernible, but in the largest example they are quite distinct. The umbilicus sometimes varies to somewhat smaller than in the type specimen.

Mud Springs, on Pine Canyon, a branch of Sabino above Sabino Basin, is a walled hole in the mud. It is on the trail from Sabino Basin to Soldier's Camp, the elevation about 7,000 ft. It is in the pine zone. The *Sonorella* was found in the first rocks east of the spring along the trail. Also at the foot of a high cliff, in stratified "porphyry," in a ravine heavily wooded with cypress (*Cupressus arizonica*), about a mile southeast of the springs.

*Sonorella marmorarius imula* n. subsp. Pl. III, figs. 7, 7a.

At Stations 17 and 19 (1917), on a limestone hill 6 miles west of Brush Corral Ranger Station, north of Alder Springs, in the northern foothills of the Catalinas, many specimens were taken, chiefly dead, differing from typical *marmorarius* by the somewhat darker color, and by having about a half of a whorl more in examples of similar diameter.

Alt. 26.5, diam. 15 mm.;  $5\frac{1}{2}$  whorls.

Eighty-five specimens from Station 19, all of the adults collected, measure as follows:

Diam. in mm. . . . .	22.3	22.4	22.5	22.6	22.9	23	23.1	23.2
Number of specimens. . .	1	1	1	3	1	3	1	3
Diam. in mm. . . . .	23.3	23.4	23.5	23.6	23.7	23.9	24	24.1
Number of specimens. . .	2	3	2	2	3	1	4	2
Diam. in mm. . . . .	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9
Number of specimens. . .	6	2	6	4	5	3	2	3
Diam. in mm. . . . .	25	25.1	25.3	25.4	25.5	25.6	25.9	26
Number of specimens. . .	4	2	2	2	2	1	2	1
Diam. in mm. . . . .	26.2	26.3	26.4	26.5				
Number of specimens. . .	1	1	1	1				

As the error in measuring may be at least 0.1 mm., it will be seen, if a curve is plotted, that the mode for diameter is at about 24.4 mm., and the total variation 2.1 mm. in either direction.

A specimen having the umbilicus exceptionally narrow is illustrated in pl. 4, figs. 8-8b. The spire is also narrower than in the typical form; yet it seems unlikely that there is more than one species in the lot.

*Sonorella galiurensis* n. sp. Pl. V, figs. 5 to 6b.

The shell is umbilicate (the width of umbilicus contained about 9 times in that of the shell), between cinnamon-brown and sayal-brown in color, fading on the base, and much paler on both sides of the broad chestnut-brown band above the periphery. Glossy; embryonic whorls closely pitted-granulate, with the usual protractive threads; subsequent whorls lightly marked with irregular growth-lines. The last whorl is wide and descends somewhat in front. The peristome is narrowly expanded. The parietal callus usually has a thickened edge in fully adult shells.

Alt. 16.7, diam. 27.5 mm.; 5 whorls. (type, Sta. 30).

" 16, " 27.4 " 5 " (Sta. 30).

" 16.4, " 25 " 5 " (Sta. 30).

" 16.7 " 30.5 " 5 " (Sta. 34).

Galiuro Mountains at the following Stations (1917):

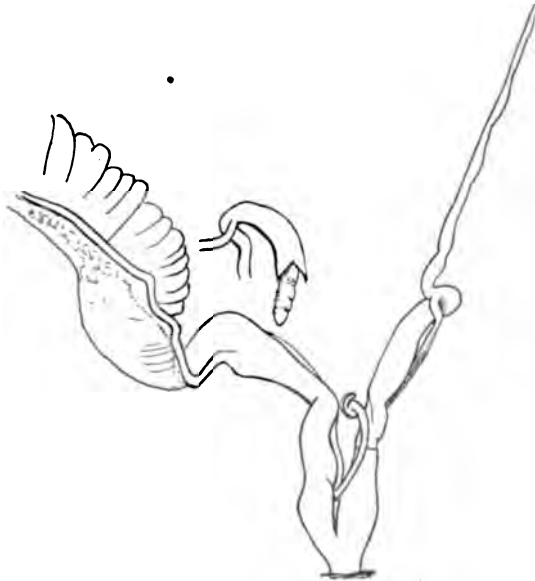


Fig. 7. Genitalia of *Sonorella galiurensis*, No. 118,122.

24. Southern slope of mountains at eastern gate of John Rhodes' ranch, among boulders on mesa.
26. Rhodes' canyon.
27. Northern slope, amphitheatre on Whitlock ranch.
28. Foot of main gulch facing north, same amphitheatre.
29. Farther up same gulch.
30. "Porphyry" slide on trail  $1\frac{1}{2}$  miles south of Copper Creek Mining Camp. Type locality.
31. Camp at smelter, Copper Creek.
32. Rock slide sloping west, on trail half way between Copper Creek Camp and Table Mountain.
33. "Porphyry" slide in forks of creek 2 miles east of Table Mountain.
34. Slide near the preceding.
35. Cliffs on northeastern slope of Table Mountain.

Genitalia (fig.7). The general proportions are as in *S. marmorarius*. The penis has a long, very thin sheath about the basal part, not seen in *marmorarius*; its lower portion is somewhat swollen and has several small longitudinal folds within. Retractor muscle long. Papilla weakly annulate, about half as long as the penis. There is the usual short flagellum. The vagina about equals the penis in length.

Length of penis .....10 mm.  
 papilla .....5 "  
 epiphallus....7 "  
 flagellum ....1.5 "  
 vagina .....9 "

Museum No. ....118,122.

This form is much like *S. marmorarius*. The shell is slightly more capacious and darker colored, and there is some difference in the penis. Its habitat is separated from that of *marmorarius* by the valley of the San Pedro River. The elevation is much less than that inhabited by *S. marmorarius*.

20 living specimens from Station 30, all taken, measure as follows:

Diameters in mm...	25	25.5	26	26.5	27	27.5	28	29
No. specimens ...	(1)	(1)	(2)	(2)	(3)	(2)	(8)	(1)

17 specimens from Station 24, a southern slope:

Diameters.....	24	24.5	25	26	26.5	27	28	28.5	30.5
No. specimens....	(1)	(2)	(3)	(2)	(4)	(1)	(2)	(1)	(1)

*Sonorella tortillita* n. sp. Pl. V, figs. 4, 4a, 4b.

The shell is umbilicate (width of umbilicus contained about  $8\frac{1}{2}$  times in that of the shell), pinkish buff, fading to white around the umbilicus and paler near the chestnut-brown band which revolves above the periphery of the last whorl and shows very narrowly above the suture on most of the penult whorl. The surface is glossy;

embryonic shell about  $1\frac{1}{2}$  whorls, the first half whorl having some radial wrinkles, the rest of the embryonic portion closely irregularly granulose, and having fine, rather indistinct, tangential (protractive) threads, often visible only near the suture. Subsequent whorls have the usual fine growth-lines. The whorls increase slowly at first, the last one very wide, suture descending slightly in front. The aperture is rounded oval-lunate. Peristome is well expanded.

Alt. 15.5, diam. 27 mm.; aperture alt. 14.3, width 15.8 mm.;  $4\frac{2}{3}$  whorls.

Tortillita Mountains, Pinal Co., Arizona, the type, No. 118,053, from Station 41 (1917), east side of Hog Canyon; also found at Station 40, west side of same canyon near the cement dam, and Station 42, south slope of mountains east of Hog Canyon.

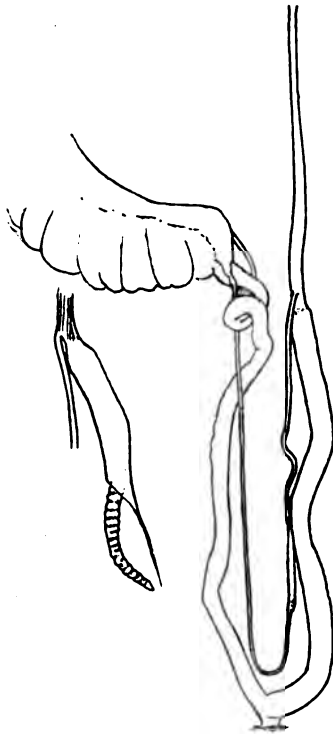
Genitalia (Fig. 8). The penis is very long and rather slender, with muscular walls, containing a long, slender, corrugated, tapering papilla. The epiphallus is shorter than the penis, without a distinct flagellum, though there seems to be a rudimentary one concealed in the integument. The penial retractor is long. Length of vagina is about equal to the penis.

By the long penis and vagina this species is related to *S. rinconensis*, but in that snail these organs are far longer. *S. santaritana* is even more like *S. tortillita* in genitalia,

Fig. 8. Genitalia of *Sonorella tortillita* with detail of the penis-papilla.

but the shell is flatter, the whorls of smaller caliber. None of the Santa Catalina species has the vagina and penis nearly so long as in *S. tortillita*. The larger shells referred to *S. sabinoensis occidentalis* are closely similar.

The embryonic sculpture described is in large part effaced in the fully adult shells found. The color, too, is somewhat faded. In the young and barely full-grown examples it is decidedly darker than described.



The largest specimen from the type locality measures 17.2x28.6 mm.; the smallest, 12.5x23.2 mm.; very few are under 25 mm. diameter. The largest shell in the lot from the west side of Hog Canyon measures 17.5x30 mm.

The Tortillitas are arid mountains without forest.

*Sonorella rinconensis* Pils. & Ferr.

*Sonorella rinconensis* PILSBRY & FERRISS, Proc. A. N. S. Phila. 1909, p. 517, fig. 1, pl. 22, figs. 1-3, 5, 7.<sup>4</sup>

Rincon range: Rincon Peak and Wrong Mountain; Mt. Mica, only those from Rincon Peak dissected. This species was not encountered in the localities visited in 1917. It inhabits elevations above 7,500 ft., occurring in granitic rocks.

*Thysanophora hornii* (Gabb).

Santa Catalina Mountains: Stations 3 and 9, near mouth of Sabino Canyon, 4,500 ft. Station 13, mouth of Bear Canyon, 4,500 ft. Station 40, Alder Springs, 8,000 ft. Southern foothills of Rincon Mountains near the cave, Station 191 (1918). Galiuro Mountains.

*Thysanophora ingersolli* (Blaud).

Santa Catalina Mountains: Mt. Lemon at Stations C, 19, 31, 34, 37, etc., at 9,000 to 9,500 ft.

#### ENDODONTIDÆ.

*Gonyodiscus cronkhitei* (Nc.)

Santa Catalina Mountains: Station 21, Desert Laboratory Plantation, 8,500 ft. Soldier Camp. Bear Wallow. Around Mt. Lemon at Station C, spring on west side; Station 19, Congdon's Cabin; Station 28, marshy spring; Station 37; Station 22, old Lemon trail; Station 31, aspens, new trail; Station 34, 9,000 to 9,500 ft.

Rincon Mountains: Spud Rock and Catalina saddle.

*Radiodiscus millecostatus* Pils. & Ferr.

Santa Catalina Mountains: Environs of Mt. Lemon, Stations C, 19, 28, 30, 31, 34, 37 and some others, at elevation of 7,000 to 9,500 ft. Bear Wallow. Kellogg Peak. Generally distributed and locally very abundant, especially in the aspen zone.

*Helicodiscus arizonensis* P. & F.

Santa Catalina Mountains: Station 1, near weir, Sabino Canyon, 4,500 ft. Station 27, Bear Wallow. Marble Peak at Station 25, 8,500 ft., and Station 26, 8,000 ft. Rincon Mountains: Spud Rock. Galiuro Mountains, Station 24 (1917).

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<sup>4</sup> The reference to figures "1-4, 7" as given in our paper was incorrect.

***Punctum californicum* Pils.**

Santa Catalina Mountains: trail from Webber's to Lemon Mountain.

**VITRINIDÆ.*****Vitrins alaskana* Dall.**

Santa Catalina Mountains: Station 37, north side of Mt. Lemon 9,000 ft.; trail to Webber's place.

**ZONITIDÆ.*****Polita indentata umbilicata* (Ckll.).**

Santa Catalina Mountains: Station A, Bear Wallow Creek. West side Mt. Lemon at Station C. Marble Peak at Stations 25 and 26, 8,000-8,500 ft. Trail from Webber's place to Mt. Lemon. Alder Spring. Rincon Mountains at Station 21 (1917), Catalina Saddle, and Spud Rock. Galiuro Mountains, Station 24.

***Striatura millium meridionalis* (P. & F.).**

Santa Catalina Mountains: Station A, Bear Wallow Creek; Soldier's Camp; Station 21, Desert Laboratory plantation, 8,500 ft.; Mt. Lemon at Stations 22, 28, 31, 37, at 9,000 to 9,500 ft.; trail to Webber's Cabin; Alder Spring.

***Zonitoides arborea* (Say).**

Santa Catalina Mountains: Station 21, Desert Laboratory plantation, 8,500 ft. Soldier Camp. Stations 19, 22, 37 on Mt. Lemon, at about 9,000 ft. Station 25, northwest ridge of Marble Peak, 8,500 ft. Rincon Mountains, Station 20 (1917).

***Zonitoides minuscula alachuana* (Dall).**

Santa Catalina Mountains: Mt. Lemon, Bear Wallow; Kellogg Peak and Alder Spring. Rincon Mountains.

***Zonitoidesingleyana* (Pils.).**

Rincon Mountains.

***Euconulus fulvus* (Mull.).**

Santa Catalina Mountains: Alder Springs. Soldier Camp. Station 27, Bear Wallow Creek. Mt. Lemon at Station C, 19, 22, 28, 30, 31, 34. Common up to 9,500 ft. Ridge from Marble Peak, southwest, 8,500 ft.; south side of Marble Peak. Rincon Mountains.

**VALLONIIDÆ.*****Vallonia cyclophorella* Ckll.**

Santa Catalina Mountains: Mt. Lemon at Stations 19, 22, 30, 31, 37, at about 9,000-9,500 ft. Marble Peak, quartzite slide on south side, 8,000 ft.

*Vallonia perspectiva* Sterki.

Santa Catalina Mountains: Marble Peak, in quartzite slide on south side, 8,000 ft., rare. Galiuro Mountains: Whitlock ranch on the northern slope.

#### PUPILLIDÆ.

*Pupoides marginata* (Say).

Southern foothills of Rincon Mountains near the cave, Shaw's Ranch, Station 148 (1918).

*Pupilla hebes* (Ancey).

Santa Catalina Mountains: Mt. Lemon, at head of the aspen gulch, and  $\frac{1}{4}$  mile below, on the new trail, 9,500 ft., and on the north side, 9,000 ft. Among those from the last locality, Station 37, 6 out of 128 were albinos. Station 22, ridge near Marshall Pass. It occurred in some abundance in all the localities except Station 22.

*Pupilla hebes nefas* Pils. & Ferr.

*Pupilla hebes* form *nefas* P. & F., Proc. A. N. S. Phila., 1910, p. 135.

Santa Catalina Mountains: Station 20, northeast side of Kellogg Peak, 8,500 ft., Station 27, Bear Wallow, 214 specimens. Soldier Camp, 63 specimens. Station 21, Desert Laboratory Station, 8,500 ft., 84 specimens. Station 22, ridge near Marshall Pass, rare. Station 29, Leaning Rock, south side Mt. Lemon, 9,500 ft., 15 specimens. Station 25, ridge of Marble Peak towards Mt. Lemon, 8,500 ft., 57 specimens. Station 26, "quartzite" slide on Mt. Lemon, 8,000 ft., 2 specimens. Station 28, marshy spring near trail, Mt. Lemon, 1 specimen. Rincon Mountains: Spud Rock; Catalina Saddle.

*P. h. nefas* almost always has a small parietal tooth, and is usually a little longer than *P. hebes*, with between 6 and 7 whorls. It differs from *P. syngenes* by having no crest behind the lip, though there is usually a shallow, wide depression there.

In only one of the numerous stations mentioned above were *hebes* and *nefas* found together. That was Station 22, where very few shells were taken. Lots from all of the other stations, frequently copious, were either all *hebes* or all *nefas*.

Elsewhere *P. h. nefas* has been found only in two places in the Chiricahua Mountains, at elevations estimated from 7,500 to 8,000 ft. It was not associated there with dextral *hebes*, which was found at another Chiricahua locality. We are now disposed to rank *P. h. nefas* as a well-marked subspecies.

*Chaenaxis intuscostata* (Clapp).

Southern foothills of the Rincons, near the Tucson-Benson highway, near the cave, Shaw's ranch, at about 3,500 ft.



***Gastrocopta ashmuni* (Sterki).**

Santa Catalina Mountains: Slide on Marble Peak, 8,000 ft., rare.

Galiuro Mountains: Whitlock ranch, on the northern slope.

***Gastrocopta cochiseensis* (Pils. & Ferr.).**

Santa Catalina Mountains: Alder Springs and Station 25, southwest ridge of Marble Peak, 8,500 ft. The shells were dirty when collected, like *B. quadridens*.

***Gastrocopta dalliana* (Sterki).**

Santa Catalina Mountains: Station 3, mouth of Sabino Canyon, 4,500 ft.

***Gastrocopta pellucida hordeacella* (Pils.).**

Southern foothills of Rincon Mountains near the cave, Shaw's ranch, Station 148 (1918), at about 3,500 ft.

***Gastrocopta bilamellata* (St. & Clapp).**

Galiuro Mountains.

***Gastrocopta quadridens* (Pils.).**

Santa Catalina Mountains: Stations 30, 31, 37, and all around Mt. Lemon at 9,000 to 9,500 ft. Soldier Camp, one specimen. When found alive, the shell is rather copiously plastered with dirt, probably attached by the mucous of the animal.

***Gastrocopta pilabryanz* (Sterki).**

Santa Catalina Mountains: Station 3, mouth of Sabino Canyon, 4,500 ft. Alder Springs, very abundant. Station 27, Bear Wallow. Station 18, Soldier Camp, 8,500 ft. Station 21, Desert Laboratory plantation, 8,500 ft. Station 22, near Marshall Pass, old Mt. Lemon trail, 9,000 ft. Station 28, marshy spring, Mt. Lemon trail, 9,000 ft. Trail to Webber's cabin. Station 31, north side of Mt. Lemon. Station 26, quartzite slide on Marble Peak, 8,000 ft. Galiuro Mountains at Whitlock ranch. Rincon Mountains: Spud Rock.

**FERUSSACIDÆ.*****Cochlicopa lubrica* (Müll.).**

Santa Catalina Mountains: Station 25, ridge to peak Mt. Lemon, 8,500 ft.; Station 26, slide on Marble Peak, 8,000 ft. Rincon Mountains: Spud Rock.

***Vertigo modesta inculpta* Pils.**

The shell is similar to *V. modesta* in contour, but differs by being closely and rather sharply striate on the intermediate whorls; the first whorl smooth, the last less striate than those preceding. There

is a narrow but moderately high crest close behind the outer lip. The color is chestnut-brown, becoming paler towards the apex. When alive both animal and shell are black. Teeth fine, a small supraparietal denticle being developed. The parietal and lower palatal folds are rather large. Length 2.6, diam. 1.35 mm.;  $5\frac{1}{2}$  whorls.

Except in external sculpture, this form resembles *V. modesta* from Alaska, figured in Proc. A. N. S. Phila. for 1900, pl. 23, fig. 2. By its sharp striation *V. m. insculpta* is quite distinct from all other large *Vertigos* of the Rocky Mountains, but there is a smaller form of *V. modesta* in Labrador which is striate on the spire.

It is very abundant between 9,000 and 9,500 ft. on Mt. Lemon, in and near the aspen zone, where several hundred specimens were collected.

Very beautiful albino specimens occurred in the colonies from Stations 30, 31, and 37, Mt. Lemon.

Other localities for *V. m. insculpta* are: Santa Catalina Mountains: Soldier Camp. Mt. Lemon at Stations 19, 22, 28, 30, 31, 34, 37, at 8,500 to 9,500 ft.

***Vertigo coloradensis inserta* Pils.**

In the original *V. c. basidens* from Bland, New Mexico, there is one parietal tooth and the basal is at the foot of the columella, remote from the lower palatal. In the Santa Catalina series there is often a small angular lamella, and the basal fold stands close to the lower palatal.

This form replaces *V. c. basidens* in the Canadian zone of the Santa Catalinas. The type is from Bear Wallow.

Santa Catalina Mountains: Desert Laboratory plantation, 8,500 ft.; Bear Wallow Creek, 8,500 ft.; Soldier Camp. Mt. Lemon at Stations 19, 22, 28, 31, 9,000 to 9,500 ft.; Alder Springs. Rincon Mountains at Station 20.

*V. c. inserta* differs from *V. c. arizonensis* by the development of a basal fold, and all of the teeth are larger.

Recent studies of the group have convinced us that *Vertigo columbiana utahensis* Sterki is identical with *V. coloradensis* Ckll. The former name is therefore superfluous. Our record of *V. c. utahensis* from the Chiricahua Mountains, in these *Proceedings* for 1910, p. 144, should be changed to *V. coloradensis*.

**ANCYLIDÆ**

***Gundlachia californica* Rowell.**

Santa Catalina Mountains: Sabino Canyon, at Alkali Spring, Lowell U. S. Ranger Station, on leaves of *Plantinus wrighti*.

Very few examples are in the *Gundlachia* stage; none were found in the septate stage. Many have the narrow, high, oblique shape of septates, but without septum. Many of them reached the normal size of septates, then had a resting stage during which the shell became blackened, subsequently resuming growth along the margins, forming a narrow, oblique shell somewhat like *A. parallelus* in outline. Other examples become wider, about as in *A. rivularis*, in the second period of growth. The early stages are similar in all, having the usual *Ferrissia* sculpture.

Those individuals in the *Gundlachia* stage do not appear specifically separable from *G. californica*.

#### PHYSIDÆ.

##### *Physa virgata* Gld.

Small specimens which appear to belong to this species were taken in lower Sabino Canyon, with *Gundlachia*.

#### LIST OF COLLECTING STATIONS IN THE SANTA CATALINA, RINCON, TORTILLITA AND GALIURO MOUNTAINS.

For the Santa Catalinas and Rincons, these stations can be located and approximate elevations ascertained by reference to the U. S. Geological Survey topographic map, Tucson Quadrangle. As different sets of station numbers were unfortunately used in different years, these numbers can only be used in connection with the dates.

#### SANTA CATALINA

##### *Stations of 1913 (J. H. F.)*

1. Sabino Canyon, bluffs on east side of creek at water gauge dam. Elevation about 4,500 ft.
2. Same, quarter mile farther up.
3. Rock slides near camp at "Picnic Grounds," Sabino Canyon.
4. Slide north of camp, 4,800 ft.
5. Mountain east of camp.
6. About 2 miles along trail to Soldier's Camp. 5,000 ft.
7. Spring near Ranger Station at mouth of Sabino Canyon (*Physa* and *Gundlachia*) 4,500 ft.
8. Mouth of Sabino, foot of bluff, west side. 4,500 ft.
9. Rocks 1 mile above camp.
10. Vantana Canyon at its mouth; a small dry canyon next west of Sabino, not named on topographic map. Ca. 4,500 ft.
11. Rock Canyon, in "quartzite" bluff. This is the second small canyon west of Sabino. About 4,500 feet.
12. Vantana Canyon, west side of east mouth. Same elevation.
13. Bear Canyon, east side. 14, same, west side, near 13.
15. Mile above camp in Sabino, on mountain slope, west side. About 5,000 ft.
16. Slide below preceding, about the same elevation.
17. First rocks below Mud Springs, on Pine Canyon (a branch of Sabino above Sabino Basin). Mud Springs are about 9 miles south of Soldier's Camp. About 7,000 ft.
18. Soldier's Camp.

19. Congden Camp.
20. Northeastern side Kellogg Peak.
21. Carnegie Desert Laboratory experiment station, Marshall Pass.
22. Ridge running down east side Lemon Mountain.
23. Ridge running south from Soldier's Camp towards Mud Springs.
24. West side of Marble Peak ridge.
25. Top of same ridge.
26. "Quartzite" slide south side of Marble Peak (same as Station 3, 1910; Station 4, 1910, is the top of same slide).
27. Ridge south of Hinkley Camp.
28. Marshy spring on Lemon Mountain trail.
29. Leaning Rock, south side Lemon Mountain.
30. Aspen Gulch, parallel with main trail to Lemon Mountain. 31, quarter mile below 30, where gulch is close to trail. 32, quarter mile farther down. 33, foot of trail at the stream. Little shells very abundant at these stations and the next.
34. Cold Spring.
35. Southeast side of Marble Peak, about Apache Camp and "Joliet Cave."
36. Northwest side Marble Peak near "Old Dan's Cabin."
37. Westfall's mine.
38. North side Marble Peak near the Daley mine.
39. Goodale's house.
40. Alder Spring, Peck Canyon (one of the head branches of Buehman Canyon). Alder Spring is about 12 miles east of Soldier's Camp Ranger Station; Brush Corral Ranger Station is about 8 miles farther down Buehman Canyon.
41. Buehman Canyon: "Quartzite" slide, Sycamore Spring.
42. Buehman Canyon: Forest Ranger pasture near lower fence, Brush Corral.
43. Buehman Canyon. Lower on the stream, towards Korn Kobb mine.
44. Buehman Canyon. Near the mine.
45. John Lyon's mountain (east of San Pedro River and Rincon Mountains, north of the Little Dragon Mountains). The rock is granite, and only *Thysanophora hornii* was found.

*Stations of 1917 (J. H. F.).*

*(Santa Catalina Range.)*

12. Main fork of Sabino Creek, at camp in Sabino Basin.
13. Head of Bear Creek (*Gundlachia* and *Physa*).
14. Head of Bear Canyon.
15. Northeast corner of Sabino Basin, on trail to Soldier's Camp. Boulder dykes along gulches.
16. Same as Station 12, in slides of mountain facing north.
17. Southwest side of Sabino Basin, big mountain in the "Window Range."
18. Brush Corral, crossing of Peck Canyon, Alder Springs.
19. Limestone mountain in foothills of S. Catalinas, San Pedro slope.

*(Rincon Mountains.)*

20. North side of the high Rincon peaks.
21. Saddle-camp, between Santa Catalinas and Rincons.
22. Ridge west of Spud Rock Ranger Station, in aspens.
23. Drift debris of San Pedro River above Mammoth.

*(Galiuro Mountains.)*

24. Drift of boulders near southeast gate of the forest reserve pasture.
25. In slides, creek bank, above John Rhodes' ranch house.
26. In slides head of the same gulch as 25.
27. In No. 4 slope in amphitheatre of the mountains on Whitlow ranch, east of Sombbrero Peak.
- 28 and 29. Other slides in the same vicinity.
30. On trail two miles south of Copper Creek mining camps.

31. Slide west across gulch from smelter, Copper Creek.
32. On trail to Table Mountain about half way from last station.
33. West of abandoned copper camp, creek running north, east of Table Mountain, in slide east of said creek.
34. Slides in same vicinity.
35. Cliffs, northeast rim of Table Mountain.

(Western slope of Santa Catalina Range.)

36. East side of Pima Canyon.
37. West side of Pima Canyon.
38. Drift debris of Pima Canyon.
39. Fork of the Canada del Oro near the foot of Marble Peak.
43. Northeast of Sutherland's ranch, in the foothills.
44. First large canyon north of Romero Canyon, and south of the Sutherland ranch.
45. About one mile east of Station 44.

(Tortillita Mountains.)

40. West side of Hog Canyon, in basin near cement dam.
41. East side of Hog Canyon, on the mountain top.

#### X—MOUNTAINS OF THE GILA HEADWATERS: THE BLUE AND WHITE MOUNTAINS, ARIZONA, AND THE MOGOLLON MOUNTAINS, NEW MEXICO.

The malacological survey of these ranges, which lie in Graham, Apache and Greenlee counties, Arizona, and Socorro county, New Mexico, was begun by one of us (Ferriss) in 1913, and continued by Ferriss and L. E. Daniels in 1914. In 1900 Dr. E. O. Wooten, well known for his work on New Mexican botany, made a ten-day trip in the Mogollons, in course of which he crossed the range from Willow Creek to Mogollon and ascended the eastern flank of Mogollon Peak to almost 9,000 feet. The type of *Ashmunella mogollonensis* was collected on this occasion. So far as we know, no other mollusks had been taken in the region of the Gila headwaters prior to the collections here described.

A few mollusks collected between the San Pedro River and Clifton, Arizona, are included, as they are geographically intermediate between the regions considered in articles IX and X.

Early in September, 1913, Ferriss left Tucson with Frank Cole, the guide of tourists and naturalists, for Mt. Thomas in southern Apache county, 11,496 feet above sea level. Traveling by wagon, brief stops were made in the Graham Mountains and upper end of the Peloncillo range. At Clifton the wagon was stored, saddle horses and pack mules secured, and the trail followed to Metcalf.

From Clifton to the Double Circle ranch on Eagle Creek it is rough country, mostly forested, and with sufficient rock for snail cover, but the snails do not like it. The trail here ran northwesterly

for about 35 miles, then directly north 16 miles on Eagle Creek to the southern rim of the Blue Mountains. Pupae and Vallonias were found at Honeymoon Ranger Station, and *Oreohelix* a mile or two farther on, fifty miles from Clifton.

The rim of the Blue has a wall of broken granite. We found *Ashmunella mogollonensis* and a grayish form of *Oreohelix cooperi*, the latter also in the quaking asp and cork-bark fir groves of the vicinity.

The route lay northwesterly again, across the K. P. *cienaga*, down Corduroy and Fish Creeks and across Black River, to Reservation Creek in Apache Co. This high plateau has a continuous forest of the largest yellow pine, blue spruce, Douglas spruce, thickets of quaking asp and alder. Pupae and *Oreohelix* were the principal snails. Few were found on the dome-like summit of Mt. Thomas.

Along Black river *Oreohelices*, from pale to nearly black, from high to low, were in every rock pile.

On the return trip the Raspberry trail from the rim of the Blue Mountain to Cospers' ranch on the Blue river was taken. Down the Blue and San Francisco rivers *Ashmunella*, *Sonorella* and *Oreohelix* were found in the slides investigated, but the journey was a hurried one. This ground was thoroughly covered in the journey of 1914.

An account of the journey of 1913 may be found in *Nautilus* for January, 1919.

On the expedition of 1914, Ferriss was accompanied by Mr. L. E. Daniels.<sup>5</sup> Part of the route taken in 1913 was retraced—from Clifton, Graham Co., Arizona, up the San Francisco and Blue Rivers to Cospers' ranch, a distance of about 50 miles. From this point they continued up the Blue River, northeast, to its head, and to Luna, Socorro Co., New Mexico. From Luna the party turned southeast, across the San Francisco Mountains (which lie south of Luna), and by way of Alma to the Mogollon Mountains. Some account of this trip was given in *Nautilus* XXVIII, February, 1915, pp. 109–113. The *Ashmunellas* collected were described and figured in *Nautilus* XXIX, June, July and August, 1915, to which the reader is referred for these matters. A map showing the collecting stations in the Mogollons may be found on page 331.

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<sup>5</sup> We have to record the death of Mr. Daniels, October 23, 1918. He was a companion of both authors on collecting trips of some months' duration, and it is a real sorrow that he will no longer share the labors of the trail or the cheer of the evening camp fire.

The San Francisco and the Blue rivers have been seriously torn up by floods in recent years, but many of the snails remain. Nearly all the farmers have been swept out. *Oreohelices*, *Sonorellas* or *Ashmunellas* exist in every favorable situation from Clifton to Bob Cat on the interstate boundary, except in a few short stretches of these rivers where the snails seem to have a dislike for the soil, the chemistry of the rocks, or something not traced. This is about fifty miles in a straight line, and thus very long miles.

Again on the Luna road to Alma, in New Mexico, *Oreohelix* was found on the crest of the San Francisco Mountains, and the largest colony, with many albinos, came from the Rio Saliz, a small stream draining the San Francisco Mountains eastward into the San Francisco River.

The Mogollons might be called a federation of sharp peaks. It is not a high plateau like the White and Blue mountain region, yet the forest conditions and tree associations are almost identical. On the Bursam wagon road from Mogollon to Willow Creek, ascending to 9,000 feet, and usually running along the north slope of the peaks, the conditions for snails are ideal. *Ashmunella mogellonensis* and *Oreohelix cooperi* were soon picked whenever logs or stones were turned in this (for snail hunters) two-day journey. At two points *Oreohelix barbata* was found with the other two species. Afterward, when the canyons facing west and south were explored the smaller *Ashmunellas* were found in colonies with the three above mentioned. *Sonorella* has not yet been found in the Mogollon range. In the extreme southern part of Arizona (Chiricahua range) the large toothless *Ashmunellas* are in colonies with the smaller toothed forms and *Oreohelix barbata* with them. Also a *Sonorella* and sometimes *Holospira*. Three species of *Sonorella* have been found in one slide; but the general Arizona rule still remains one species of the genera of *Helices* to a colony.

The banks of the canyons running west, in the Mogollons, were abrupt, and the south bank furnished shade and cover. In Big Dry Canyon, running directly south, the banks were so abrupt and close together that snails were living on both sides of the stream, and in the greatest abundance within our experience.

The wide differences in the *Ashmunellas* of the Mogollons and the presence of the Chiricahua *Oreohelix barbata* seem to indicate an alluring future for Mogollon conchology. We believe that the deeper canyons, penetrating farther into the large mountains, had greater riches than Big Dry, lying in between them. Here too in the

canyon streams live the mountain trout, friendly and well conditioned, but they are not the cut-throat trout of the Colorado.

On the whole the Mogollons, in scenery and camping delights, are not far behind the White and Blue Mountain region of eastern Arizona. Silver City is the nearest and most convenient railway station, and moreover it lies in a region unexplored by the snail fraternity.

One more killing was made on the return to Clifton, a colony of *Sonorellas* at Steeple Rock, Sept. 14. Thus this event of 1914 had a continuous run of two months and seven days.

Aside from the minute Canadian Zone snails which have a wide distribution at high levels, and the minutiae of the desert foothills such as *Thysanophora hornii*, *Succinea avara*, the small *Zonitoides*, etc., there are several forms showing close affinity between the San Francisco-Mogollon region and the Chiricahua Range. The species *Sonorella binneyi*, *Ashmunella chiricahuana* and *Orohelix barbata* of the Chiricahuas are represented here by *S. binneyi franciscana*, *A. mogollonensis* and *O. barbata*. The toothed *Ashmunellas* are of nearly related species, and the same group of forms extends farther east in New Mexico to the Black Range. None of the species mentioned are found in the northern or Dos Cabezas part of the Chiricahua range, their habitats being from 80 to over 100 miles south of the regions now under consideration. The intervening region is at the present time too dry for the existence of these snails.

#### HELICOIDÆ.

*Sonorella grahamensis* n. sp. Pl. VI, figs. 7, 7a, 7b.

The shell is umbilicate (the width of umbilicus contained about  $8\frac{1}{2}$  times in the diameter of shell), very *thin*, tawny-olive, paler at the base, with the usual band; not very glossy; under the lens showing the usual weak growth-lines, and both above and below there are *numerous spiral impressed lines*. Whorls slowly increasing at first, the last rapidly widening, descending in front. Aperture rounded-oval, quite oblique. Peristome is thin, very little expanded.

Alt. 10, diam. 19 mm.; umbilicus 2.2 mm.;  $4\frac{1}{2}$  whorls.

Genitalia (fig. 9). The penis has a well developed sheath at the base, and contains a long, tapering papilla. The penial retractor is inserted at the base of epiphallus and apex of penis as in the *hachitana* group. There is a short flagellum. The organs measure:

Length of penis 9 mm.; papilla 7; epiphallus 6; flagellum 0.5; penial retractor 4.7; vagina 7; spermatheca and duct 19 mm.





Fig. 9. Genitalia of *S. grahamensis*, with two details of the penis-papilla. Type specimen.

Mt. Graham, in the Pinaleno Range, Graham Co., Arizona, type No. 109,101 A. N. S. P., collected by J. H. Ferriss, 10-14-1913.

Graham Mountain is composed of crumbling granite (similar to that of Nine-mile Water Hole in the Dos Cabezas range), and is very dry on both north and south sides. On top there is yellow pine and quaking asp forest. Camp was made in Stockton Pass, and a couple of hours' collecting done at Mud Spring, on the summit. Besides *Sonorella* and *Oreohelix*, *Vitrina alaskana* was abundant, and two young *Vallonia*s were found. The Pinaleno Range lies in line with the Chiricahua system, though separated by a rather wide mesa, in which the Southern Pacific R. R. runs, from the northern end of the Dos Cabezas Mountains.

*S. grahamensis* is not closely related to any other species known to us. The delicate, spirally striate shell and the rather fusiform penis-papilla are characteristic.

***Micrarionta praesidii* n. sp.** Pl. VI, figs. 8, 8a, 8b.

The shell is depressed, umbilicate (the width of umbilicus contained about 5.7 times in the diameter), thin. The "dead" shell is grayish white above, pale ecru-drab below, with some radial white streaks, and at the shoulder a narrow, faintly traced gray band which becomes cinnamon towards the aperture. Under a lens fine gray spiral lines are seen in places on the base. The initial half whorl is smooth;

next whorl has hyphen-like tubercles parallel with the suture, not closely placed; subsequent whorls have faint growth-lines only; there is no trace of spiral striæ.

The whorls are rather strongly convex, at first slowly increasing, the last very wide, rather deeply descending in front. The aperture is strongly oblique, nearly circular, faintly washed with ochraceous within. The peristome is sharp, very little expanded except at the columellar insertion where it is broadly dilated; terminations connected by a rather long, quite thin parietal callus.

Alt. 8.5, diam. 16 mm.; umbilicus 2.8 mm.;  $4\frac{1}{2}$  whorls.

Fort Grant, at foot of the Graham Range, Graham Co., Arizona, the type, No. 58,121 A. N. S. P., collected by Dr. George H. Horn.

By the sculpture of the embryonic shell, as well as the general appearance, this snail resembles *Micrarionta hutsoni* Clapp, which is smaller, more depressed, with a larger umbilicus. It is somewhat intermediate in form, between *hutsoni* and *indioensis*. If it really belongs to *Micrarionta*, and there is no mistake about the locality, it is widely separated from its congeners.

The single specimen has been in the collection for many years. It had been labelled *H. strigosa* Gld.

Dr. Horn, the distinguished coleopterist, was stationed at Fort Grant sometime after 1863. He collected a number of shells in that vicinity, which were described by W. M. Gabb in the American Journal of Conchology for October, 1866, pp. 330, 331, as follows:

*Helix hornii* Gabb. [*Thysanophora hornii*].

*H. strigosa* Gld. "The largest specimen I have seen of the species" [= *Sonorella* sp. undet.].

*H. minuscula* [*Zonitoides minuscula alachuana*].

*Pupa* (*Modicella*) *arizonensis* Gabb [= *Pupoides marginata* var.].

*Pupa hordacea* Gabb [*Pupoides hordacea*].

The locality is given as "Fort Grant, at the junction of the Arivapa and San Pedro Rivers;" but that junction is really a long day's travel—fully fifty miles—westward; yet it may have been the nearest definite landmark to be found on maps of the time.

The "*H. strigosa*" mentioned by Gabb is a *Sonorella* 25 mm. in diameter, of the *S. hachilana* group. The upper part of the peristome is broken away, and the shell is bleached; we do not recognize the species.

Of the *Zonitoides* several live specimens are preserved. They probably came from around a spring. All of the other shells mentioned are such as live among rocks in arid foothills. The speci-

men of *Pupa hordacea* seems to have been given to Mr. Binney; the other species taken by Dr. Horn are in the collection of the Academy.

As Dr. Horn was also at Gila Bend, Yuma and other places in western Arizona, the possibility of an erroneous locality label for the specimen of *M. praesidii* is to be considered. That specimen was not mentioned in Gabb's paper, but he would doubtless have considered it a small "*H. strigosa*".

*Sonorella rooseveltiana* (Berry). Pl. VI, figs. 9, 9a, 9b.

*Nautilus* XXXI, July, 1917, p. 14.

Roosevelt, Gila Co., Arizona, 2200 ft. elevation. Figures of the type, supplied by Dr. Berry, are here given for comparison with the forms of adjacent counties. They are 1.6 natural size, the diameter being 16.5 mm.

*S. rooseveltiana* appears to belong to the *hachitana* group, but the single specimen dissected was quite immature. It is, we believe, the only mollusk reported from Gila County.

*Sonorella delicata* n. sp. Pl. VI, figs. 6, 6a, 6b.

The shell is umbilicate (umbilicus contained slightly over 6 times in diameter of shell), thin, somewhat translucent, light ochraceous-buff with several pale or whitish oblique streaks on the last whorl, and a cinnamon-brown band above the periphery. Glossy, having the usual weak irregular growth-lines. The embryonic whorls are nearly smooth, but short, protractive threads may be seen near the suture.

The last whorl is wide and descends rather slowly in front. The aperture is strongly oblique, rounded-oval. Peristome thin, expanded, with a dull brown edge.

Alt. 10.5, diam. 18.3 mm.;  $4\frac{1}{2}$  whorls.

Genitalia (fig. 10) remarkable for the small size of the male organs. The length of penis is about one-fifth the diameter of the shell, very slender, having a stout basal sheath, and containing a short, cylindric papilla. The epiphallus is longer than the penis, terminating in a short flagellum.

Length of penis	3.5 mm.
papilla	1.2 "
epiphallus	4.5 "
flagellum	0.4 "
vagina	5.5 "

Northern end of the Peloncillo Range, about 6 miles south of the Gila River, on the toll road between Solomonsville and Clifton,

Graham Co., Arizona; in a "malpais" rock slide, about 4,800 ft. elevation, type No. 109,110 A. N. S. P. paratypes in Ferriss Coll.; collected by J. H. Ferriss, 11-14-1913.

The shell recalls *S. bowiensis* Pils., differing by the wider last whorl, smaller aperture and somewhat smaller umbilicus; also much less distinct sculpture of the embryonic whorls. The genitalia, examined in several individuals, differ by the very small size of the male organs, relatively even smaller than in *S. hachitana* and its

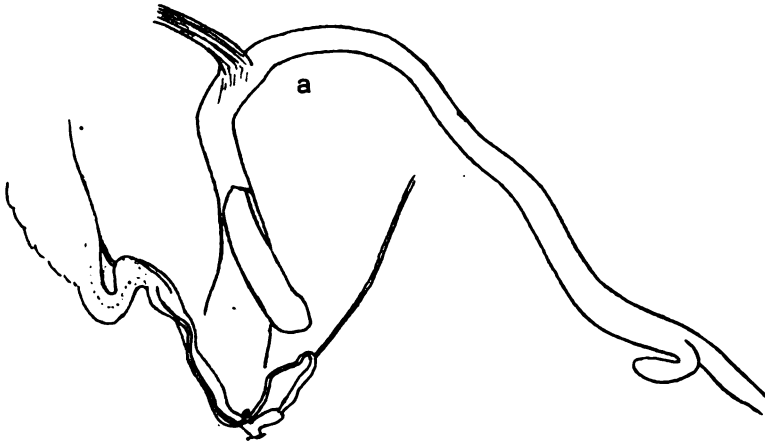


Fig. 10. Genitalia of *S. delicata*. a, outline of penis-papilla, epiphallus and flagellum.

immediate relatives. It differs from these by the cylindric penis-papilla with bluntly conic end. The genitalia of *S. walkeri* P. & F., of the Santa Ritas, have considerable similarity.

The living animal has an odor like *S. odorata* in the Santa Catalinas.

*Sonorella caeruleoaluminis* n. sp. Pl. VI, figs. 1 to 1.

The shell is depressed, umbilicate, the umbilicus contained about 8 times in the total diameter, somewhat translucent, nearly isabella color, having a chestnut-brown band at the shoulder, showing above the suture on the penult and usually half of the next earlier whorl, and without white bordering bands, though the shell may be slightly paler there. It is somewhat translucent throughout. Surface glossy. Embryonic portion of  $1\frac{1}{2}$  whorls, at first with some radial ripples, then irregularly pitted-granulose, with weak oblique threads as in others of the *S. hachitana* group. First post-embryonic whorl is weakly striate and minutely papillose; later whorls with sculpture of delicate, irregular growth-lines only. The whorls are moderately

convex, the last descending slowly in front. The aperture is rounded oval-lunate, large. Peristome expands a little and is dilated at the columellar insertion.

Alt. 14.6, diam. 25 mm.; alt. of aperture 12.3, width 14.3 mm.;  $4\frac{1}{2}$  whorls (type, Station 18).

Blue and San Francisco Rivers, Graham Co., Arizona, the type (No. 119,048 A. N. S. P.) from Station 18 (1914), San Francisco River 6 miles above its confluence with the Blue River. Found also at Stations 5, 8, 10, 15, 16, 17, 19, 20 (1914), and 89, 91 (1913); from Ash Canyon, 6 miles above Clifton, to the mouth of Sardine Creek on the Blue River. The higher of these colonies are at little more than 4,000 ft.

While closely related to *S. hachitana*, it differs from that by the absence of white bands bordering the shoulder-band, and of a white umbilical area, by the suture descending less deeply and not so abruptly in front, and by the smooth penis-papilla.



Fig. 11. Genitalia of *Sonorella caeruleifumina*. a, No. 119,048, Station 18, typical, with enlarged detail of penis-papilla; b, No. 119,042, Station 19; c, Station 16, No. 119,046.

The head and back are blackish brown, fading downward and backward to dark grayish brown, the tail paler. The sole has lateral bands somewhat darker than the central field (No. 119,048).

Genitalia (fig. 11) generally similar to *S. hachitana*. The penis is very slender, its retractor muscle longer; penis-papilla slender, smooth, with tapering end. A short flagellum is present. The epiphallus is nearly as long as the penis. The vagina is generally longer than the penis.

In one specimen dissected, Station 20 (fig. 12a), the penis is about a third longer, its papilla very long, three times the usual length or more. The flagellum also is much longer. Such differences would usually be thought specific, yet I have not found any differences in the shells from this locality.

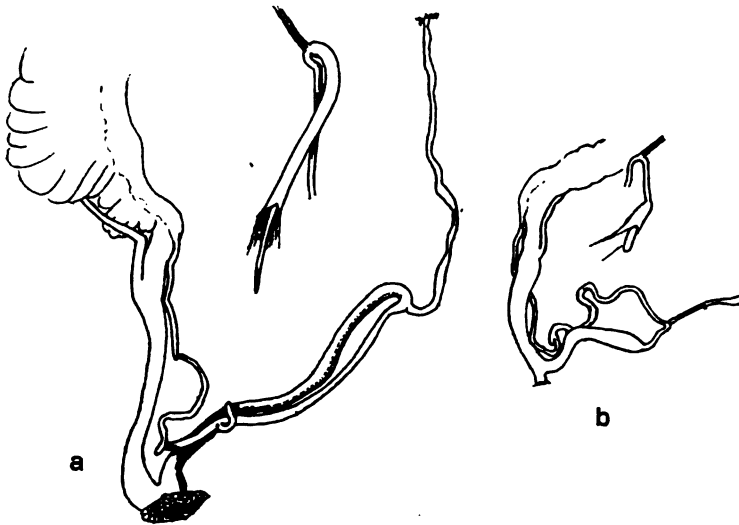


Fig. 12. a, Genitalia of *S. caeruleifluminis* var., 119,047, from Station 20, Blue River. b, *S. binneyi franciscana* No. 119,044.

Measurements of genitalia of *S. caeruleifluminis*.

Collecting Station. . . .	18	19	16	20
Penis. . . . .	8.5	7.5	7	12
Penis-papilla. . . . .	3	3.5	4	11
Epiphallus. . . . .	8	6	7	8.7
Flagellum. . . . .	0.6	0.7	0.5	2
Retractor. . . . .	..	..	10	13
Vagina. . . . .	15	14	8	9.5
Museum No. . . . .	119,048	119,042	119,046	119,047

The size of the shell is rather variable, the extremes of diameter in a series from Station 17 being 20 and 24.6 mm. The largest specimen noticed measures 26.4 mm. An individual without a dark band is photographed in fig. 4. It is from Station 19, Blue River, at the mouth of Pigeon Creek. Two other shells from this station are illustrated in figs. 2, 2a and 3, 3a.

*Sonorella binneyi franciscana* n. subsp. Pl. VI, figs. 5, 5a, 5b.

The shell is umbilicate (width of umbilicus contained 9 to 10 times in that of shell), light pinkish cinnamon with some paler or white oblique streaks and indistinctly paler on both sides of a chestnut-brown band above the periphery. This band shows above the suture of the last half of the penult whorl. The surface is glossy; embryonic shell of about  $1\frac{1}{2}$  whorls, the first half having some radial ripples, the next whorl minutely granulate, having oblique, curved threads, protractive below, retractive above; the later whorls with fine, unequal growth-lines. The whorls are convex, slowly increasing at first, the last rapidly widening, descending a little in front. The aperture is unusually large, shortly oval-lunate. The peristome is very narrowly expanded, straightened and dilated towards the columellar insertion.

Alt. 11.6, diam. 19mm., aperture 9.8x11.5 mm.;  $4\frac{1}{2}$  whorls.

San Francisco River, Graham Co., Arizona; type locality, Station 92 (1913), above Sardine Creek. Also taken at Station 93 in the same vicinity, and at Station 13. (1914), 2 miles above Harper's. Ferriss and Daniels.

The head and back are dark grayish brown shading into dark vinaceous drab downward and backward, the tail light colored.

Genitalia (Fig. 12b). The penis contains a cylindric papilla with blunt, rounded end. The epiphallus is about twice as long as the penis, and bears a small flagellum. The *penial retractor inserts on the epiphallus some distance (over  $\frac{1}{4}$  mm.) above the penis*. The vagina is nearly or about as long as the penis. Measurements follow:

Station.....	13	13	93
Length of penis .....	5	6	7 mm.
papilla .....	2	2.3	3.5 "
epiphallus .....	10.5	10	10.5 "
flagellum .....	0.5	0.7	small
penial retractor.....	3.3	..	..
vagina.....	4.7	5	5.5 mm.
Museum No.....	119,044	119,044	109,413

By its genitalia and shell this subspecies is closely related to *S.*

*binneyi* P. & F., of the southern Chiricahuas. The blunt penis-papilla, and especially the insertion of the penial retractor on the epiphallus some distance beyond the apex of the penis, are alike in both. There are, however, some differences in the proportions of the organs, the epiphallus and penis-papilla being longer relative to the penis in *S. b. franciscana*, and the last whorl of *franciscana* is a little wider, viewed from above.

The diameter, in specimens seen, is from 17 to 19.3 mm.

***Ashmunella pilsbryana* Ferriss.**

*Ashmunella pilsbryana* Ferriss, Nautilus XXVII, 1914, p. 109.

*Ashmunella pilsbryana* Ferriss & Pilsbry, Nautilus XXIX, 1915, p. 42, pl. 2, fig. 3.

Arizona: Along the San Francisco River, from near Harper's Ranch to 2 miles above the mouth of the Blue River, Graham and Greenlee Counties, Arizona.

***Ashmunella mogollonensis* (Pils.).**

*Ashmunella chiricahuana mogollonensis* Pilsbry, Proc. A. N. S. Phila., 1905, p. 252, pl. 16, figs. 101, 102.

*Ashmunella mogollonensis* PILSBRY, Nautilus XXIX, 1915, p. 42. PILSBRY & FERRISS, Proc. A. N. S. Phila., 1917, p. 93, pl. 7, fig. 10 (shell), and pl. 10, fig. 3 (genitalia).

Professor E. O. Wooten, who discovered this snail, crossed the Mogollon Range from Willow to Silver Creeks, along what is now called the Bursam road. He also made an excursion from the West Fork of the Gila towards Mogollon Peak, reaching a point about  $1\frac{1}{2}$  miles due east of the Peak, in the forks of Whitewater Creek, at about 9,000 ft. It was probably here that he obtained the type of *A. mogollonensis*, though it is also common along Silver Creek and the Bursam Road.

Specimens were taken along Silver Creek and the Bursam Road at Stations 38, 42, 43, 44, 45, from about 7,500 to 9,000 ft. elevation, and at Station 46, Little Turkey Creek, at about 9,000 ft.

It is rather variable in size, specimens from Station 38 measuring from 16.5 to 21 mm. diameter, those from Station 46 from 17 to 19 mm. Other localities in the Mogollons are Station 51, head of Mineral Creek, where there are some beautiful albino shells, and 70, 76, 79, on Dry Creek, the shells mostly large.

In Arizona it was taken in 1913 at Stations 59, 84, 86, all on or near the rim of the Blue Mountains, at 5,500 to 12,000 feet. The shells average larger than in the Mogollons, very few being under 20 mm. in diameter. Specimens from Station 59 measure:



Alt. 11.5 diam. 22.8 mm.  $5\frac{3}{4}$  whorls.

" 11 " 21 "  $5\frac{3}{4}$  "

" 8.5 " 18.3 "  $5\frac{1}{4}$  "

Extremes of size, Station 86.

Alt. 11 diam. 22.8 mm.  $5\frac{3}{4}$  whorls.

" 10 " 19.5 "  $5\frac{3}{4}$  "

*A. mogollonensis* differs from *A. chiricahuana* by the very small and short penis, scarcely differentiated from the epiphallus; the absence of a penial retractor muscle; and the more capacious spermatheca, which is sacculate distally in some individuals. There are also differences in the proportions of the organs, but whether constant or not can be determined only by measuring a long series. In both the epiphallus is very long. The shells can be distinguished by the minute but deeply engraved spiral lines of *A. mogollonensis*.

Other species of *Ashmunella* from the Mogollon Mountains were described in *Nautilus* XXIX, 1915, as follows:

*Ashmunella tetrodon* Pils. & Ferr. Dry Creek.

*Ashmunella tetrodon mutator* Pils. & Ferr. Dry Creek.

*Ashmunella tetrodon inermis* Pils. & Ferr. Dry Creek.

*Ashmunella danielsi* Pils. & Ferr. Cave Spring Canyon.

*Ashmunella danielsi dispar* Pils. & Ferr. Little Whitewater Creek.

***Oreohelix cooperi*** (W. G. B.). Pl. VII, figs. 1 to 6a.

Mogollon Mountains, Socorro Co., New Mexico: Willow Creek, Stations 46-48, at from about 8,300 to nearly 9,000 ft.; Silver Creek and along the Bursam Road (above Mogollon), at about 7,500 to 9,000 ft., Stations 39, 40, 42,  $42\frac{1}{2}$ , 43, 44; also Station 35.

The specimens from these localities closely resemble those figured by us from the Black Range, N. M. (in these *Proceedings* for 1917, pl. 9, figs. 5-9), but there is greater variation in contour, as in pl. VII, figs. 6, 6a from Station  $42\frac{1}{2}$ , near the crest of the range, measuring

Alt. 13, diam. 21 mm.

" 16.5, " 20 "

The commonest form is like that shown in pl. 9, fig. 7 of our paper of 1917; the size generally from 21 to 23 mm. diam. A large shell from Station 48 measures, alt. 16.4, diam. 23.3 mm. At Stations 39 and 40 they are smaller, diam. 18 to 20 mm. The size is independent of elevation, as there are larger shells both above and below these stations in the Willow Creek region.

In Arizona the same "Black Range form" of *cooperi* was found on the southern slope of the Blue Mountains, Station 59 (1913),

in Cosper's pasture, Station 58 (pl. VII, fig. 1) and farther northward in the southern part of Apache Co., on Mt. Thomas, White Mountains, at Station 75 (1913). In all of these stations there are the same capacious whorls and frequently very high spire noted in the Mogollons.

All of the preceding inhabit high elevations, and all were found under logs and leaves in heavy timber, as in the Black Range of New Mexico. The following lots were all among rocks (pl. VII, figs. 2-5b).

Farther down the Blue River (in Greenlee Co., Arizona), the species was found as far as Station 23, east side of the river 2 miles above the mouth of Grant Creek (pl. VII, figs. 5-5b). While there is abundant intergradation with the shells of higher elevations just noticed, the majority of the shells are more openly umbilicate. Many have the spire very high, but this is variable in all the lots. Three examples from Station 23 figured measure:

Alt. 16,	diam. 26.5 mm.,	umbilicus 4.7 mm.
" 18,	" 24 "	" 4.5 "
" 17.8	" 23 "	" 3 "

The shells from Station 25 are almost as large; those from Stations 26 to 32 (going up the river) are smaller. Specimens from Station 29, 1 mile above Blue River Ranger Station (pl. VII, figs. 2-2b) measure:

Alt. 17,	diam. 22.3 mm.
" 18	" 22.2 "
" 15	" 22 "
" 15.6,	" 18 "



Fig. 13. *Oreohelix cooperi*, albino, Station 29.

There are some beautiful albino specimens in this lot (fig. 13). Other examples are figured (pl. VII, figs. 3, 3a) from Station 27, near the Blue River Ranger Station, where the shells are very dark colored. One measures, alt. 13, diam. 20.5, umbilicus 5 mm.

A series from Station 36, Mt. Lisa, Lisa Creek, Socorro Co., N. M., 20 miles north of Alma, is similar to those of Station 29, also with not a few albino shells.

The Blue River series shows all gradations of shape between very high shells, those of the typical *cooperi* contour, and an openly umbilicate shell with whorls of small caliber. The sculpture varies from that of Black Range *cooperi* to more effaced, the striation and spirals weak.

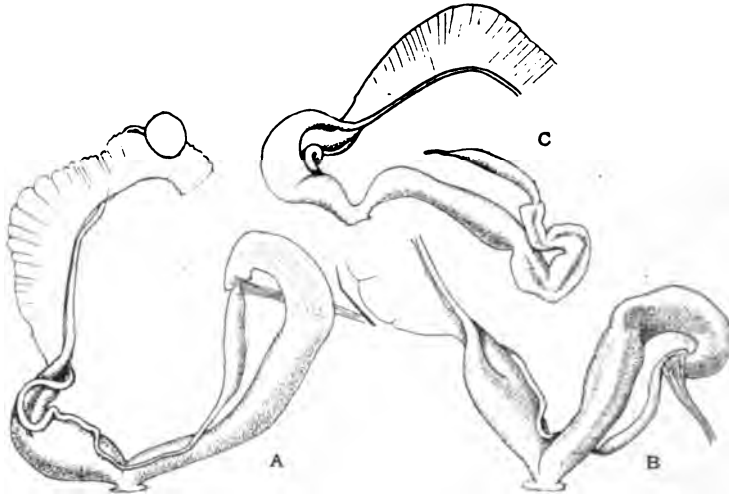


Fig. 14. Genitalia of *Oreohelix cooperi*. a, Cosper's pasture; b, Blue River, Station 26; c, form *apache*, Black River, Station 81.

The genitalia (figs. 14a, b, c) agree with those organs in *O. cooperi* from the Black Range, N. M., figured in these *Proceedings* for 1917, p. 101, fig. 5. The internally ribbed portion of the penis forms more than half of the total length of that organ, as in all forms of *O. cooperi*. Measurements in mm. follow. Numerous other specimens opened but not measured were seen to agree with those illustrated. They are distinguishable at sight from all forms of *O. strigosa*.

Station.	Penis.	Internally ribbed part of penis.	Epiphall- lus.	Vagina.	Diam. of Shell.	Museum No.
26 (1914).	16	9	6	6	23	119,151
58 (1913).	17	10	7	5	21	109,173
35 (1914).	13	7.5	...	...	20	119,152
36 (1914).	13	8	...	...	21	119,153
23 (1914).	18	10	...	7	24	119,150
76 (1913).	19	10.5	6	...	23	109,184
81 (1913).	18	9.5	...	4.5	23	109,180
81 (1913).	17.5	8	6.3	...	...	109,180

Preparations are figured from Stations 26, Blue River (fig. 14b), 58, Cosper's pasture (fig. 14a) and 81, Black River (fig. 14c). The specimen dissected from Station 36 is an albino.

*O. cooperi* form *apache*, new form (pl. VII, figs. 7 to 8a). Rather large size, dark or very dark coloring and subobsolete sculpture (the spirals being especially weak) characterize the shells taken along the Black River and Fish Creek, in Apache County, Arizona. The shell is generally quite depressed and as openly umbilicate as the forms of *O. strigosa*. The diameter is usually from 22 to 26 mm. Few have the spire very high, and none are as high as many of the Blue River shells.

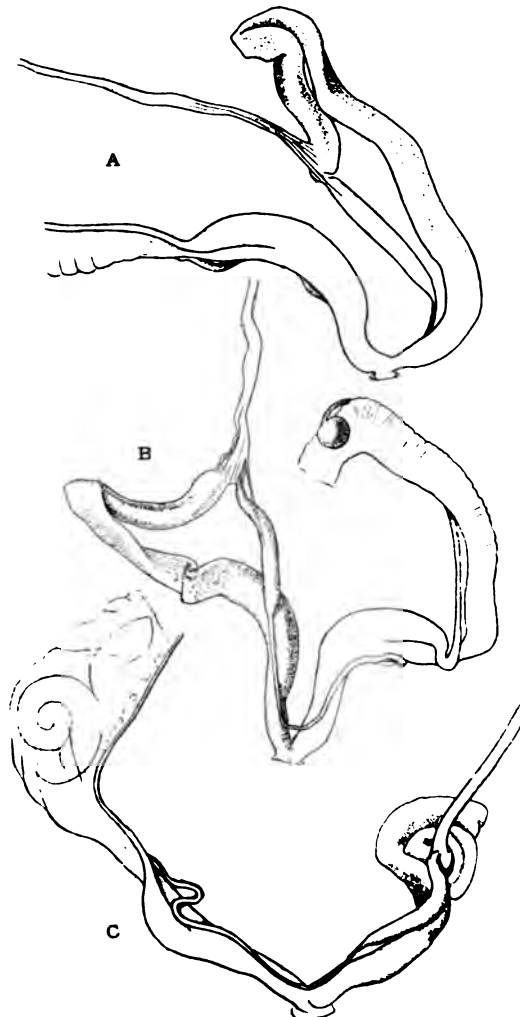


Fig. 15. Reproductive organs of *Oreohelix strigosa meridionalis*, the middle figure drawn from the type specimen.

Alt. 15, diam. 24 mm., umbilicus 4.5 mm.

Type No. 109,184, from Station 76 (1913), Black River 2 miles above Fish Creek. It was taken also at Stations 53, 60-62, 64, 66, 68, 69, 71, 72, 76-81, 83 of the expedition of 1913.

On account of the form and sculpture of this large series, so unlike the usual forms of *cooperi*, it appears best to name it. The Blue River series varies from the *apache* type to the normal *cooperi* form. Indeed, specimens could be selected from the Mogollon series agreeing with *apache*, though they are quite exceptional there. The genitalia are either practically typical *cooperi*, as at Station 76, or the costate part of the penis may be relatively a trifle longer, as at Station 81 (fig. 14c).

*Oreohelix strigosa meridionalis* n. subsp. Pl. VII, fig. 9.

The shell is depressed and very openly umbilicate, the last whorl subangular above the aperture; otherwise resembling *O. c. apache*. Striation weak, subobsolete spiral lines only very faintly developed.

Alt. 14.4, diam. 24.5 mm.; umbilicus 6 mm. wide;  $5\frac{1}{2}$  whorls.

Y Salt House branch of Eagle Creek, Graham Co., Arizona; type No. 109,186 A. N. S. P. Also taken on the Black River near the horseshoe bend.

By the shells alone we would hardly separate this form from *O. cooperi apache*; yet the genitalia were found to be like *O. s. depressa*.

The genitalia (fig. 15) agree with those of *O. s. depressa* and various allied forms except that the organs are longer in shells of similar diameter; yet in Colorado *depressa* this is a rather variable character, and it is somewhat affected by the conditions of preservation. The penis is very long, its internally costate portion hardly one-third of the entire length, having about 4 principal ribs within; the internally papillose portion flattened, weakly ribbed within, sometimes having a trilobed section distally. Measurements of the organs in mm. follow:

Station (1913).	Penis.	Internally costate portion.	Epi-phallus.	Vagina.	Diameter of shell.	Fig.	Museum No.
56	33	9	10	9	24	15b	109,186
.....	31	10	8	10	.....	15a	109,177
71	19.5	6	5	6.5	22	.....	109,179
.....	28	7.5	6	8	21.5	15c	109,190

*O. s. meridionalis* differs from *O. s. depressa* by the distinctly smoother shell.

***Oreohelix barbata* Pils.**

The occurrence of this species in the Mogollons was a surprise, as it was described from the Cave Creek region of the Chiricahuas, far to the south. It does not inhabit the dryer northern half of the Chiricahua range, and its distribution is therefore conspicuously discontinuous. It evidently changes much more slowly than the *Ashmunellas*, though some little differentiation may be seen as noted below.

In *Dry Creek*, it was taken in the slides with *Ashmunella*, at Stations 62, 64, 68, 70, 72, 75, 77, 78 and 79. In most of these colonies it reaches large size, even larger than in the Chiricahuas. Two examples from Station 79 measure: height 8, diam. 16 mm., and height 9, diam. 15.4 mm. Usually there are several circular fringes on the last whorl above the periphery, and more on the base than in Chiricahua examples. In the latter, fringes above are exceptional. Counting that at the periphery, there are usually 8 to 11 spiral wreaths in *Dry Creek barbata*, 6 to 10 in Chiricahuan specimens. In some lots the cuticular appendages are mostly or quite lost in the adult stage. Some consist partly of smaller individuals; and at Stations 64 and 75 all are small, 11–12 mm. in diameter.

*Cave Spring Canyon*, Station 57. Very small, about 10 mm. diameter, and agreeing well with *O. b. minima* P. & F. (Proc. A. N. S. Phila. 1910, p. 94, fig. 15) from Rucker Canyon, Chiricahuas. There is probably no direct relationship, each being presumably a diminutive race of the normal larger forms of their respective ranges. These small forms show decadence by the deep descent of the last whorl to the aperture.

*Willow Creek*, Station 46. This is on the eastern slope of the Mogollon watershed. The size is small, diameter about 11 mm. Cuticular appendages usually deciduous.

***Thysanophora hornii* (Gabb).**

Arizona: Station 45 (1913), John Lyon's Mountain, north of the Little Dragons. Blue River, Station 18 (1914), and Little Blue River, Greenlee Co.

New Mexico: Station 76, *Dry Creek*, west side of the Mogollon Mountains.

***Thysanophora ingersolli* (Bld.).**

Arizona: Reservation Creek, 9,500 ft.; Fish Creek; Horseshoe bend of Black River, and 2 miles above, at 9–10,000 ft. Apache Co. Cosper's pasture, Graham Co.

New Mexico: Stations 38, 42, 45, 51, 57 in the Mogollon Mountains, abundant.

#### ENDODONTIDÆ.

*Gonyodiscus cronkhitei* (Nc.).

Arizona: Cospers' pasture, 11,000 ft., and rim of the Blue Mountains, 12,000 ft., Graham Co.; Blue River, Station 29 (1914), Greenlee Co. White Mountain Camp at Mt. Thomas, 13,500 ft., Apache Co.

New Mexico: Stations 36, 42, 45, 46, 57 in the Mogollon Mountains, abundant.

*Radiodiscus millecostatus* Pils. & Ferr.

Arizona: Little Blue River, Greenlee Co.; Cospers' pasture and Station 59, head of "hot air trail" rim of Blue Mountains, 12,000 ft., Graham Co.; Reservation Creek, Apache Co.

New Mexico: Station 45, Willow Creek, Mogollon Mountains.

*Helicodiscus arizonensis* (P. & F.).

Arizona: Cospers' ranch, on the Blue River, 5,060 ft.

New Mexico: Stations 36, 42, 55, 57, Mogollon Mountains.

*Punctum conspectum* (Bld.).

Arizona: Station 75 (1913), Thomas Peak, Apache Co.

New Mexico: Willow Creek, Mogollon Mountains, at Station 45 (1914).

These shells appear to be somewhat more glossy than the Californians compared, the spiral striation better developed, and the riblets irregularly developed; yet we would hesitate to separate the specimens from this widely spread west coast species.<sup>6</sup>

*Punctum pygmaeum* (Drap.).

Arizona: Station 70 (1913), Black River near the Horseshoe bend; somewhat abundant. This is the first record of the species for Arizona.

#### ZONITIDÆ.

*Polita hammonis electrina* (Gld.).

Arizona: Station 80 (1913), Black River. One example. There are no spiral striæ.

*Polita indentata umbilicata* (Ckll.).

Arizona: Blue River at Cospers' ranch, 5,060 ft., and Stations

<sup>6</sup>A form of this species was collected in great numbers about bushes in a meadow at the west end of Oswego, Clackamas Co., Oregon, by Mr. John A. Allen in 1913 and 1914. It differs from typical *P. conspectum* by the larger size and decidedly higher, conic spire, and may be called *Punctum conspectum alleni*. The type measures, alt. 1.7, diam. 2.3 mm. (No. 111,413 a, A. N. S. P.). A specimen of *P. conspectum* received from Bland measures, alt. 1.25, diam. 2.1 mm.—H. A. P.

18, 29 (1914); Little Blue; rim of Blue Mountains, 12,000 ft.; also in Apache Co. on Fish Creek, 10,500 ft.

New Mexico: Stations 38, 42, 46, 55, Mogollon Mountains.

*Striatura milium meridionalis* (P. & F.).

Arizona: Cosper's pasture, 11,000 ft., Graham Co.; Black River and Reservation Creek, 9,500 ft., Apache Co.

New Mexico: Station 57, south fork of Whitewater Creek, Mogollon Mountains.

*Zonitoides arborea* (Say).

Arizona: Station 29, Blue River; Cosper's pasture and rim of the Blue Mountains, Graham Co.; Reservation Creek and Fish Creek, Apache Co. Up to 12,000 ft.

New Mexico: Stations 38, 42, 46, 50, in the Mogollon Mountains.

*Zonitoides minuscula alachuana* (Dall).

Arizona: Graham Mountain, Graham Co.; Station 6, foot of Copper King Mountain. Reservation Creek, Apache Co.

New Mexico: Big Dry Creek, Mogollon Mountains.

*Zonitoides singleyana* (Pils.).

Arizona: Station 6 (1914), foot of Copper King Mountain, 1 mile below Harper's, Graham Co.

*Euconulus fulvus* (Müll.).

Arizona: Station 58, Cosper's pasture, 59, rim of Blue Mountains, Graham Co.; Reservation Creek and Station 75, White Mountain Camp, 13,500 ft.

New Mexico: Stations 38, 42, 45, 46, 47, 50, 53, in the Mogollon Mountains.

#### VITRINIDÆ.

*Vitrina alaskana* Dall.

Arizona: Rim of Blue Mountains, 12,000 ft., Graham Co.; Reservation Creek, Apache Co., 9,000 ft.

New Mexico: Stations 45, 46, Willow Creek, Mogollon Mountains.

#### VALLONIIDÆ.

*Vallonia perspectiva* Sterki.

Arizona: Graham Mountains; Cosper's ranch of the Blue River, 5,060 ft.; Ole Hagen's ranch on Eagle Creek. Abundant.

New Mexico: Station 38, Silver Creek above Mogollon, and 57, south branch Whitewater Creek; also Big Dry Creek, Mogollon Mountains.

*Vallonia cyclophorella* Ckll.

Arizona: Cosper's pasture and rim of Blue Mountains, Graham Co.; Reservation Creek, Apache Co. 9,500 to 12,000 ft.



**FERUSSACIDÆ.*****Cochlicopa lubrica* (Müll.).**

Arizona: Graham Mountain; Little Blue River; Cosper's on the Blue River; rim of Blue Mountains, Graham Co.; Fish Creek, Apache Co.

New Mexico: Stations 38, 42, 46, Mogollon Mountains.

***Pupilla blandi pithodes* Pils. & Ferr.**

Arizona: Reservation Creek, and head of Black River, Apache Co.; Cosper's pasture, Graham Co. New Mexico: Stations 38, 45, 46, 47, 53 Willow Creek, Mogollon Mountains, at about 9,500-10,000 ft.

This is the same race found in great abundance along the summit of the Black Range, N. M. It is larger, especially wider, than typical *P. blandi*, the crest is weaker the striation stronger. The lip is but little thickened within, and the three teeth are well developed. It is of a walnut-brown color.

Length 3.7, diam. 1.7 mm.;	$7\frac{1}{2}$ whorls.	} 115,361 A. N. S. P.
" 3.25 " 1.75 "	$6\frac{1}{2}$ "	
" 3.05 " 1.7 "	$6\frac{1}{4}$ "	

***Pupilla hebes* (Ancey).**

Arizona: Cosper's pasture and rim of Blue Mountains, Stations 58, 59, Graham Co.; Reservation Creek, Apache Co. 9,500 to 12,000 feet.

***Gastrocopta ashmuni* (Sterki).**

Arizona: Cosper's ranch on the Blue River, 5,060 ft.; Ole Hagen's ranch, Eagle Creek. Very few found.

New Mexico: 8 Stations in the Mogollon range.

***Gastrocopta dalliana* (Sterki).**

Arizona: Station 6 (1914), foot of Copper King Mountain, near Harper's place; Ole Hagen's, Eagle Creek, Graham Co.

***Gastrocopta quadridens* Pils.**

New Mexico: Stations 42 and 47, Silver and Willow Creeks, Mogollon Mountains.

***Gastrocopta pilsbryana* (Sterki).**

Arizona: Graham Mountains; Ole Hagen's on Eagle Creek; Cosper's ranch, Blue River; Little Blue River; Cosper's pasture; Horseshoe of Black River; Fish Creek. From about 5,000 to 11,000 ft.

New Mexico: Stations 38, 45, 47, 50, on Silver, Willow, Turkey and Big Dry Creeks, Mogollon Mountains. It is generally distributed over the wooded country covered in this report.

***Vertigo ovata* Say.**

Arizona: Station 6, foot of Copper King Mountain, 1 mile below Harper's place, Graham Co.

***Vertigo concinnula* Ckll.**

New Mexico: Stations 38, 42, 45, 50, 53 (1914), on Silver, Willow and Turkey Creeks, Mogollon Mountains, Socorro Co.

***Vertigo coloradensis arizonensis* P. & V.**

Arizona: Red Sack, Graham Mountains; Horseshoe bend of Black River, Apache Co.

New Mexico: Station 38, Silver Creek, 53, Willow Creek, 50, Turkey Creek, 57, south fork Whitewater Creek, Mogollon Mountains.

***Vertigo modesta insculpta* Pils.**

Arizona: Cosper's pasture and rim of Blue Mountains; Graham Co.; Reservation Creek, White Mountains, Apache Co.

***Columella alticola* (Ingersoll).**

New Mexico: Station 45, Willow Creek, Mogollon Mountains.

**SUCCINEIDÆ.*****Succinea avara* Say.**

Arizona: *Cienega* near Solomonsville, Graham Co.

New Mexico: Station 46, Willow Creek, Mogollon Mountains.

**PHYSIDÆ.*****Physa virgata* Gld.**

Arizona: Stations 19 and 20, Blue River.

***Physa* sp. undet.**

Arizona: Reservation Creek, near the Big Spring, Apache Co. With only immature specimens and broken adults an identification is difficult.

**UNIONIDÆ.*****Anodonta dejecta* Lewis.**

Arizona: Black River, southern border of Apache Co.

"Subfossil" valves of this species are found in the banks of the Santa Cruz river at Tucson.

COLLECTING STATIONS OF J. H. FERRISS IN GRAHAM, GREENLEE AND APACHE COUNTIES, ARIZONA, IN 1913.

47. Near Mud Springs, trail on summit of Big Graham Mountains.
48. Tank 10 miles south of Solomonsville (*Physa* only).
49. Swampy place 7 miles south of Solomonsville (*Physa* only).
50. Rock slide on the right side of the toll road, 6 miles south of Coronado. Peloncillo Range.
51. Eagle Creek.
52. Eagle Creek, 3 miles above the fork, east bank.

- 53-54. Eagle Creek, 5 miles above the forks.
- 55. Eagle Creek, 5 miles above the forks, west side.
- 56. Y Salt House branch (west fork) of Eagle Creek,  $\frac{1}{2}$  mile above Hot Air Salt House.
- 57. 4 miles above mouth of Y salt house branch on Hot Air trail.
- 58. Cosper's pasture, top of the Blue Mountains, 12,000 ft.
- 59. Southern rim of the Blue Mountains.
- 60. Fish Creek, beaver dam camp. Apache Co.
- 61-65. Rock slides along Fish Creek.
- 66-72. Black River, near Horseshoe bend.
- 73. Reservation Creek, 2 miles below Big Springs.
- 74. Camp 4 miles below Big Springs (*Physa* and *Pisidium*).
- 75. Head of Black River, camp 2 miles below summit of Thomas Peak (summit 13,500 ft.). White Mts., Apache Co., Ariz.
- 76-83. Black River, 2 miles above Fish Creek.
- 84. Y Salt House trail, rim of Blue Mountains, 12,000 ft.
- 85. Below the same.
- 86. Raspberry or East Eagle trail, 3 miles above Cosper's place on the Blue River.
- 87-88. Between Cosper's and the Little Blue River.
- 89. Mouth of the Little Blue River, 4,000 ft.
- 90. Spring 3 miles below mouth of Little Blue (*Physa*).
- 91. Sardine Creek 1 mile above mouth.
- 92. San Francisco River opposite Sardine Creek.
- 93. Rock slide on the east bank of San Francisco River, 3 miles below Station 92.

COLLECTING STATIONS OF J. H. FERRISS AND L. E. DANIELS IN GRAHAM AND GREENLEE COUNTIES, ARIZONA, AND SOCORRO COUNTY, NEW MEXICO, 1914.  
List compiled by Daniels.

- 4. Gila River drift at Guthrie, Arizona. (Stations on the San Francisco River.)
- 5. Ash Canyon one mile below Harper's on the "Frisco" (San Francisco) River, six miles above Clifton, Arizona.
- 6. One mile below Harper's, west side of Frisco River, foot of Copper King Mountain.
- 7, 8. Ash Canyon, above Station 5.
- 9. Branch of Ash Canyon below Station 5, one mile below Harper's.
- 10. Ash Canyon opposite Station 5, one mile below Harper's.
- 11. Top of Copper King Mountain, N. W. of Colorado Mine. 6 miles above Clifton. Elevation 4,500 ft.
- 12. Top of Copper King Mountain, west of Colorado Mine. 4,500 ft.
- 13. Slide on east bank of Frisco River, two miles above Harper's ranch and eight miles above Clifton.
- 14. Frisco River, two miles above mouth of Blue River.  
(Stations on the immediate banks of the Blue River, Greenlee Co., Arizona.)
- 15. Four miles up from the mouth of the Blue River.
- 16. Five miles up the Blue River.
- 17, 18. Six miles up the Blue River.
- 19. Blue River at mouth of Pigeon Creek.
- 20. One mile down the Blue River from Base Line Ranger Station, east bank.
- 21. Little Blue River; same as Station 89 (1913).
- 22. "The Chimneys," three miles above Cosper's Ranch. Elevation 5,853 ft.
- 23. East side of Blue River one half mile below Grant Creek. 6000 ft.
- 24. One mile above Grant Creek, east side of Blue River.
- 25. Near Geo. Thompson's Ranch, three miles below Blue Post Office.
- 26. One mile above Blue Post Office. Elevation 6,100 ft.
- 27, 28. Near Blue Ranger Station.
- 29. One mile above Blue Ranger Station. (Twenty-one miles south of Luna, New Mexico, and 65 miles north of Clifton, Arizona.)
- 30. East side of Blue River, nearly at the top of the mountain.
- 31. Blue River south of the saw mill.

*(Stations in New Mexico.)*

- 32. East side of Blue River, one mile north of saw mill.
- 33. East side of Blue River, three miles north of saw mill.
- 34. Mill Hollow, near top of hill, San Francisco Mountain, 8,500 ft.; about 8 miles southwest from Luna.
- 35. Near the Alma Wagon Road, 10 miles from Luna, in a rock slide surrounded by poplars. Crest of San Francisco Mountains.
- 36. Salix Mountain, east side of Salix Creek, 20 miles north of Alma, elevation 7,000 ft.

*(Stations in the Mogollon Range.)*

List compiled by Ferriss. Approximate positions are shown in fig. 16.

- 37-41. Along Silver Creek above Mogollon City.
- 42. Near saw mill, head of Silver Creek.
- 43, 44. Bursam Road, between Silver and Willow Creeks.
- 45-49. Willow Creek.
- 50. Turkey Creek.
- 51, 52. Head of Mineral Creek.
- 53, 54. Head of Willow Creek.
- 55. Little Whitewater Creek.
- 56-58. South Fork of Little Whitewater.
- 59. Cave on Spring Creek.
- 60-80. Big Dry Creek.

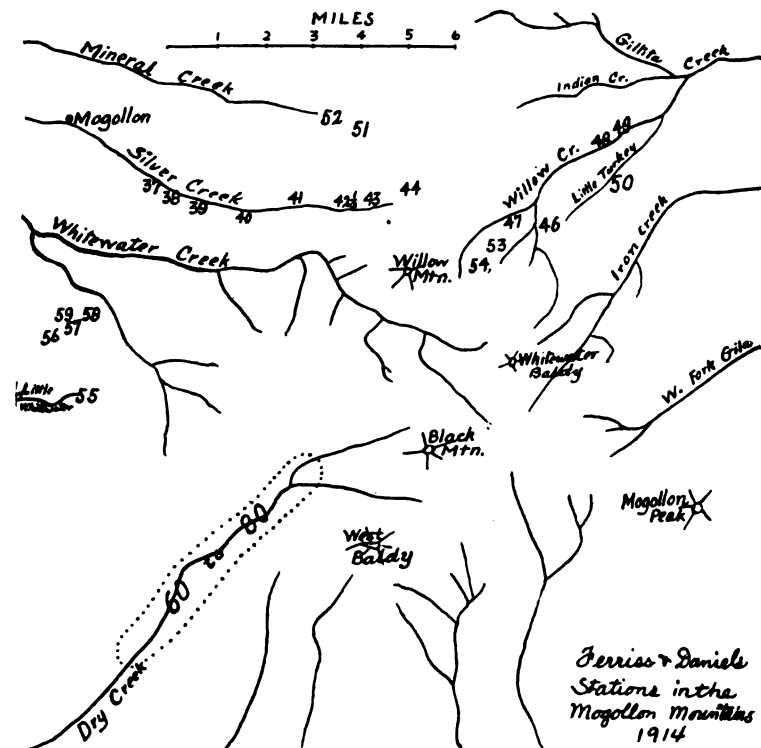


Fig. 16. Part of the Mogollon Mountains, Socorro Co., N. M. Canyons traced from U. S. Geological Survey Topographic Map, Mogollon Quadrangle, and reduced  $\frac{1}{2}$ .

## EXPLANATION OF PLATES III TO VII.

PLATE III.—Figs. 1a, 1b, 2.—*Sonorella odorata* n. sp. Station 18 (1917), a gulch 75 yards east of Alder Spring. No. 119,501.

Figs. 3, 3a, 3b.—*Sonorella odorata* n. sp., type. Head of Alder Canyon. No. 119,033.

Fig. 4.—*Sonorella odorata* n. sp. Form with narrow umbilicus. Station 18 (1913), Soldier Camp. No. 119,499.

Figs. 5-5b.—*Sonorella marmorarius limifontis* n. subsp., type. Station 17 (1913), bluffs near Mud Spring. No. 119,500.

Figs. 6, 6a, 6b.—*Sonorella odorata marmoris* n. subsp., type. Station 36 (1913), Old Dan Gulch, northwestern side of Marble Peak. No. 109,075.

Figs. 7, 7a.—*Sonorella marmorarius imula* n. subsp., type. Station 17 (1917), limestone hill, 6 miles northwest of Brush Corral, in the northern foothills. No. 119,503.

Figs. 8-8b.—*Sonorella marmorarius imula* n. subsp. Station 19 (1917), same limestone hill. No. 119,502.

Figs. 9-9b.—*Sonorella marmorarius* n. sp., type. Station 26 (1913), Marble Peak. No. 109,078.

PLATE IV.—Figs. 1-1b.—*Sonorella sabinoensis* n. sp. Half mile west of camp near mouth of Sabino canyon. No. 109,094.

Figs. 2-2b.—*Sonorella sabinoensis* n. sp., type. Station 16, mouth of Sabino Canyon. No. 109,097.

Figs. 3-3b.—*Sonorella sabinoensis* n. sp. Station 16 (1913). No. 119,487.

Figs. 4-4b.—*Sonorella sabinoensis* n. sp. Station 9, 2 miles above camp near mouth of Sabino Canyon. No. 119,488.

Figs. 5, 5a, and 5b-5d. *Sonorella sabinoensis* n. sp. Bear Canyon, Station 13 (1913). Depressed and elevated individuals. No. 119,490.

Figs. 6-6b. *Sonorella hesternia* n. sp., type. Station 148 (1917), Shaw ranch, southern foothills of the Rincons. No. 119,489.

PLATE V.—Figs. 1-1b.—*Sonorella sabinoensis occidentalis* n. subsp., type. Station 36 (1917), south side of Pima Canyon. No. 119,491.

Figs. 2-2b.—*Sonorella sabinoensis buehmanensis* n. subsp., type. Station 44 (1913), Buehman Canyon near Korn Kobb mine. No. 109,198.

Figs. 3-3b.—*Sonorella sabinoensis buehmanensis* n. sp. Station 43 (1913). Buehman Canyon. No. 119,492.

Figs. 4-4b.—*Sonorella tortillita* n. sp. Station 41 (1917), east side of Hog Canyon, Tortillita Mountains. No. 118,053.

Figs. 5-5b.—*Sonorella galiurensis*, n. sp. Station 30 (1917). Trail 1½ miles south of Copper Creek mining camp, Galiuro Mountains. Top and face views of type, base of a paratype. No. 119,493.

Figs. 6-6b.—*Sonorella galiurensis* n. sp. These views of a topotype. No. 119,493a.

PLATE VI.—Figs. 1-1b. *Sonorella caeruleifuminis* n. sp., type. Station 18 (1914), west side of Blue River 6 miles above mouth. No. 119,048.

Figs. 2, 2a, 3, 3a.—*Sonorella caeruleifuminis* n. sp. Station 19, Blue River at mouth of Pigeon Creek. No. 119,042.

Fig. 4.—*Sonorella caeruleifuminis* n. sp. An albino specimen from the same station. No. 119,316.

Fig. 5.—*Sonorella binneyi franciscana* n. subsp., type. Station 92 (1913), east side of San Francisco River above Sardine Creek. No. 119,052.

Figs. 6-6b.—*Sonorella delicata* n. sp. Type. No. 109,110.

Figs. 7-7b.—*Sonorella grahamensis* n. sp. Type. No. 109,101.

Figs. 8-8b.—*Micrarionta præsidi* n. sp. Type. No. 58,121.

Figs. 9-9b.—*Sonorella rooseveltiana* Berry. Type  $\times 1.6$ . No. 3733 Berry collection.

- PLATE VII.—Fig. 1.—Station 58 (1913), *Oreohelix cooperi* (W. G. B.). Cosper's pasture, rim of Blue Mountains. No. 109,173.  
Figs. 2-2b.—*O. cooperi*. Station 29 (1914), west side Blue River, 1 mile above Blue River Ranger Station, Arizona. No. 119,178.  
Figs. 3, 3a.—*O. cooperi*. Station 27, near preceding station. No. 119,179.  
Fig. 4.—*O. cooperi*. Station 32, east side Blue River, N. M. No. 119,497.  
Figs. 5-5b.—*O. cooperi*. Station 23, east side Blue River. No. 2.  
Figs. 5-5b.—*O. cooperi*. Station 23, east side Blue River, 2 miles below mouth of Grant Creek, Arizona. No. 119,150.  
Figs. 6, 6a. *O. cooperi*. Station 42½, Bursam Road, head of Silver Creek, Mogollon Mts., 8,000 ft. No. 119,498.  
Fig. 7.—*O. cooperi apache* n. subsp., type. Station 76 (1913), Black River, 2 miles above Fish Creek. No. 109,184.  
Figs. 8, 8a.—*O. cooperi apache*. Station 53 (1914). Black River. No. 109,183.  
Fig. 9.—*Oreohelix strigosa meridionalis* n. subsp., type. Y Salt House Fork of Eagle Creek. No. 109,186.

## DECEMBER 17th.

MR. CHARLES MORRIS in the Chair.

Twenty-one persons present.

The deaths of the following members were announced:

Herbert Norris, M.D.

Benjamin H. Smith.

A. Robinson McIlvaine.

The reception of the following papers was reported:

## NOTE ON GISTEL'S GENERA OF FISHES.

BY DAVID STARR JORDAN.

In 1848, Johannes Gistel of Stuttgart published a peculiarly confused and crabbed volume called *Naturgeschichte des Thierreichs, für höhere Schulen*, containing new generic names offered as substitutes for old ones, and in every department of Zoölogy. Most of the names he proposed to change were regarded by him, often without reason, as being preoccupied. The book seems to have been overlooked by workers in systematic zöology, and in every field.

In this paper I give the names of genera of fishes, as offered by Gistel. Nearly all of these occur in Gistel's introductory pages, these having their pagination in Roman. For a transcript of the names referring to fishes I am indebted to Mr. Barton A. Bean of the U. S. National Museum, and to Mr. C. Davies Sherborn of the British Museum. I have later received a copy of the book itself through the courtesy of Mr. E. P. Van Duzee of the California Academy of Sciences.

Of Gistel's new names, the following seem to be valid:

ABRON Gistel, p. X, replaces *Platystoma* Agassiz.

DAPALIS, p. XI, replaces *Smerdis* Ag. (fossil).

ENIXE, p. IX, replaces *Drepane* Cuvier, and also the substitute name, *Harpochirus* Cantor, 1849.

HYPODYTES, p. VIII, intended to replace *Apistus* or *Apistes* Cuvier; but its use by Quoy and Gaimard is especially mentioned and the language used (highly elliptical) ("*Aspistes* Quoy, Astrol., Fisch.") would indicate that *Apistus longispinis* should be taken as type. This species is type of *Paracentropogon* Bleeker, which name *Hypodytes* should apparently replace.

NOTACMON, p. IX, replaces *Eurynotus* Ag. (fossil).

ODONUS, p. XI, is offered as a substitute for *Xenodon* Rüppell (1835), preoccupied. It is prior to *Erythron* Rüppell and *Pyrodon* Kaup, also offered as substitutes. But Swainson in 1839 called the same genus *Zenodon*, but whether offered by Swainson as a substitute or as a characteristic piece of carelessness is not made clear, most likely the latter. Fowler accepts *Zenodon* as a substitute for



*Xenodon*, instead of *Erythrodon*. The question of *Zenodon* versus *Odonus* may be left for later decision.

PIRENE, p. IX, replaces *Dascyllus* Cuvier, on account of the earlier *Dascillus*. But *Dascyllus* has been sometimes spelled *Dascillus*.

PERIURGUS, p. X, replaces *Microps* Ag. (fossil).

PROSCINETES, p. X, replaces *Microdon* Ag. (fossil); this is prior to *Polypsephis* Hay, 1899, also a substitute for *Microdon*.

SECUTOR, p. IX, replaces *Devezimentum* Fowler. *Secutor* is apparently intended as a substitute for *Equula*, but Gistel indicates as his type *Equula insidiator*. He says: "*Equula* (*E. insidiator*, Fisch.) *Secutor* N." *Centrogaster equula* Gmelin is, however, the tautotype of *Equula* Cuv., which is a synonym of *Leiognathus* Lac. *Secutor* (*Devezimentum*) is tangibly different from *Leiognathus* (*Scomber edentulus* Bloch) as a genus or sub-genus.

STREPHON replaces *Brontes* C. & V. if distinct from *Ar<sub>es</sub>* C. & V.

STROTES replaces *Platysomus* Ag. (fossil).

In case names differing from older ones only in gender or some minor point in spelling are to be rejected as preoccupied, the following additional names of Gistel would become tenable:

ANALITHIS, p. X, intended to replace *Platyrhina* M. & H. on account of the prior *Platyrhinus*. This antedates Garman's substitute name of *Discobatus*.

ALAZON, p. X, intended to replace *Pæcilia*, on account of the earlier *Pæcilus*.

ENGLOTTOGASTER, p. IX, to replace *Oreinus* on account of *Oreina*. But the genus *Oreinus* is of doubtful validity.

FURO, p. IX, to replace *Eugnathus* Ag., (fossil) on account of the prior *Eugnatha*.

MYRMILLO, p. X, to replace *Mustelus* Cuv. on account of the prior *Mustela* L. It is equivalent to *Pleuracromylon* Gill.

PEDITES, p. IX, to replace *Macropodus* Lac., an ill-formed name, on account of the prior *Macropus*. This may perhaps be allowed.

PRENES, to replace *Scatophagus* Cuv., on account of *Scatophaga*. This is prior to Cantor's substitute name of *Cacodoxus* (1849).

RHADAMISTA, p. VIII, is offered instead of *Ctenodus* (fossil) on account of the prior *Ctenodon*.

AGOREION, p. X; presumable type *Acanthoderma spinosum* Agassiz (fossil). This is offered as a substitute for "*Scleroderma* Agassiz," used in Fungi, and in the form of *Sclerodermus* for a genus of bees. But I find no genus "*Scleroderma*" in Agassiz's works. The name is probably a slip of memory, for *Acanthoderma* Agassiz (1848), which is really preoccupied, *Acanthoderma* Cantraine (1835); on this supposition *Agoreion* may be provisionally accepted in place of *Acanthoderma*.

SCROPHA, p. VIII, is offered in place of *Ceratodus* (fossil), on account of *Ceratodon*.

Other names suggested as substitutes are plainly inadmissible. These among fishes are the following, arranged in the order given by Gistel (the alphabetical order of the names to be displaced):

CARCHARIAS, p. VIII, for *Acanthias* Risso, on account of the prior *Acanthia*. But *Acanthias* is a synonym of *Squalus* L., as properly restricted, and *Carcharias* is twice preoccupied.

PELONECTES, p. VIII, for *Acanthodes* Ag., said to be preoccupied, which it is not, but is replaceable by the original form *Acanthoëssus* Ag.

GREMILLA, p. VIII, for *Acerina* Cuvier, but *Acerina* Gùldenstädt, *Cernua* Schäfer and *Gymnocephalus* Bl. & Schn. are older.

ADIAPNEUSTES, p. VIII, substitute for *Acrodus* Ag. (1838), wrongly regarded as preoccupied by *Acrodon* Zimm. (1840).

HISTIODROMUS, p. VIII, for *Anastomus* Gronow, 1763; revived by Scopoli, 1777, therefore not preoccupied by *Anastomus* Illiger, 1835.

NOMALUS, p. VIII, for *Ancylodon*, preoccupied by another substitute name; *Macrodon* Schinz (1822).

CERDO, p. VIII, as substitute for *Asellus* Klein. Klein mentions *Asellus* only in a footnote under *Callarias* (*Gadus*). The name "*Cerdones*" appears in connection with the cod-fish, and *Cerdo* may be regarded as a synonym of *Gadus* L.

SCROFARIA, p. VIII, a needless substitute for *Ausonia* Risso, itself a synonym of *Luvarus* Raf.

GLISCUS, p. VIII, substitute for *Blochi* Volta (fossil) for no reason, save Gistel's objection to personal names, in his scheme allowable only among plants and the very lowest animals.

THALASSOKLEPHTES, p. VIII, a substitute for *Caninoa* Nardo, because it is improper to compare a prince (Charles Lucien

Bonaparte, prince of Canino) to a shark; "*Ist denn der Prinz von Canino mit einen Hayen vergleichlich?*"

CAPELLARIA, p. VIII, for *Chironectes* Cuvier, preoccupied, but already replaced by *Antennarius* Cuv.

CÆSO, p. VIII, a substitute for "*Chrysophrys* Rüppell," that is for *Chrysophrys berda* Rüpp.; a synonym of *Sparus*.

ECHEMYTHES, p. VIII, an unexplained substitute for *Chryso-tosus* Lac., itself a synonym of *Lampris*.

RONCHIFEX, p. VIII, a substitute for *Cossyphus* Cuv., preoccupied, but *Bodianus* Bloch and *Harpe* Lac., are still older names for the same genus.

PODAGER, p. IX, a substitute for *Gerres* Cuvier, on account of *Gerris*, an older name of a genus of insects. *Podager* is preoccupied in birds and thus cannot replace *Gerres*. We must use *Catochaenum* Cantor (1849) if *Gerres* is discarded; but *Gerres* and *Gerris* are words from different roots.

SYNERGUS, p. IX, a substitute for *Megalurus* Ag. (fossil) preoccupied in mammals. But *Synergus* is also preoccupied (Hartig, 1840, a genus of bees). I have therefore proposed the new name *Urocles* Jordan as a substitute for both *Megalurus* and *Synergus*, the type being *Megalurus lepidotus* Ag.

ELLOPS, p. IX, a substitute for *Helops*, a genus of sturgeons, *ἑλλοψ* being the original Greek form.

APECHES, p. IX, a substitute for *Johnius* Bloch, a personal name.

NEANIS, p. IX, a substitute for *Julis* Cuvier, regarded as preoccupied by *Julus* L. But the two words are of different origin and meaning.

EXOLES, p. IX, a substitute for *Lamia* Bon., itself a synonym of *Lamna* Cuvier.

APEPTON, p. IX, a substitute for *Gouania* Nardo, a personal name.

ANEPISTOMON, p. IX, a substitute for the preoccupied name *Leptorhynchus* Smith, itself a synonym of *Ophisurus* Lac., as restricted.

SPANIUS, p. IX, a substitute for the preoccupied name, *Lep-tosoma* Nardo, which is itself probably a synonym of *Monochirus* Raf.

MAINA, p. IX, a substitute for *Lethrinus* Cuvier, regarded as preoccupied by *Lethrus* Fabricius, a genus of beetles.

MASSARIA, p. IX, a substitute for *Liparis*, on the ground that the latter is used in botany.

ORODINUS, p. IX, a substitute for *Lophotes* Giorna, 1803, for no reason.

PASCHALTESTES, p. IX, a substitute for *Macquaria* Cuv. & Val., a personal name, before it was applied to the river Macquarie.

ARNION, p. X, an unexplained substitute for *Mugil* L.

PLECTROSTOMA, p. X, a substitute for *Oxyrhina* Ag., preoccupied. Both names are synonymous with *Isurus* Raf.

EUPORISTA, p. X, a synonym for *Plagusia* Bon, preoccupied. Both names are synonymous with *Symphurus* Raf.

DEPORTATOR, p. X, a substitute for *Plotosus* Lac., on account of the similarity of *Plotosus* to *Plotus* L.

DEMIURGA, p. X, a substitute for *Rhina* Bonaparte, a genus of rays, on account of *Rhina* (Oliver, 1807), a genus of beetles. But *Rhina*, in this connection dates from Schneider (1801). The name *Rhina* was also employed by various writers in place of *Squatina*, its first binomial use in this connection dating from 1810, although occurring in polynomial reprints from Klein at earlier periods.

If *Rhina* is used for *Squatina*, the name *Demiurga* should replace *Rhamphobatis* Gill (1861), itself also a substitute for *Rhina* Schneider.

CREOTROCTES, p. X, a substitute for *Pelamys* C. & V. (1831) subsequent to *Palamita* Bonaparte, 1832, also a substitute for the same preoccupied name, itself a synonym of *Sarda* Cuvier, 1829. If *Sarda* Plumier (1802) (= *Ocyurus* Gill) is accepted *Palamita* would hold.

DENIUS, p. X, a substitute for *Sargus* Cuvier, preoccupied; both are synonyms of *Diplodus* Raf.

BORBORODES, p. X, a substitute for *Scymnus* Cuvier, preoccupied in beetles. But the substitute name of *Scymnorhinus* Bonaparte (1846) has priority.

PEROPTERA, p. XI, a substitute for *Perioptera* Gistel, but I find neither name elsewhere.

ORTHOCOLUS, p. XI, a substitute for *Thymallus* Cuv., regarded as preoccupied by *Thymalus* Latreille (1803), a genus of beetles. But the root-words of the two names are different, and as a substitute for *Thymallus*, *Choregon* Minding (1832) is prior to *Orthocolus*.

TROMPE, p. XI, 109; an unexplained substitute for *Toxotes* Cuvier (1817), perhaps on account of the later *Toxotus* (1821).

APHOBUS, p. XI, a substitute for *Trachidermus* Heckel, preoccupied as *Trachyderma*. But *Centridermichthys* Richardson (1844) for the same group has priority over *Aphobus*.

CHÆTICHTHYS, p. XI, a substitute for *Trichodon* Cuvier, regarded as preoccupied by *Trichoda* and *Trichodes*, but the root-meaning of *Trichodon* is different.

LITHULCUS, p. XI, a substitute for *Trichopodus* (*Trichopus*) Lac. (1802, p. 125), because used in botany. But the same genus had been already called *Osphromenus* by the same author (p. 116).

ENDYNAMA, p. XIII, 108; a substitute for *Chrysophrys* Cuvier, itself a synonym of *Sparus* L., as restricted.

EUPNŒA, p. 105; type *Plagusia lactea* Bon., a synonym of *Symphurus* Raf.

ATTILUS, p. 109; a needless synonym of *Umbrina* Cuvier, "*der Schattenfisch*."

MELANTHA, p. 109; a needless synonym of *Corvina* Cuvier, "*die Seekröhe*."

## NEW GENERA OF FISHES.

BY DAVID STARR JORDAN.

In the preparation of a catalogue of the generic names which have been applied to fishes, the writer has noted a number of valid genera and subgenera, which have either received no name or are recorded under a name already preoccupied. Some of these form the subject of the present paper.

**AORIA** Jordan.

Type: *Bagrus lamarrii* Cuv. & Val.

A substitute for *Macrones* Duméril, preoccupied by *Macrones* Newman, 1841, a genus of *Coleoptera*.

**AZURELLA** Jordan.

Type: *Pomacentrus bairdi* Gill, *Microspathodon bairdi* Jordan.

This genus resembles *Microspathodon* Günther, with which it agrees in the peculiar dentition (uniserial, movable teeth) and in general structure, differing in having the vertical fins not elevated and the caudal simply limate. The nostril in *Azurella bairdi* is much larger than in *Microspathodon dorsalis*, which species we infer is congeneric with *M. chrysurus* (Cuv. & Val.), the little-known type of the genus. The genus *Stegastes* Jenyns (*S. imbricatus*) (1842) is probably identical with *Microspathodon* (Günther, 1862) and of earlier date. This matter demands further investigation.

**COTYLICHTHYS** Jordan.

Type: *Cotyliis fimbriata* Müller & Troschel.

The genus *Cotyliis*, as first indicated by Müller (Wiegmann's Archiv., 1843, p. 297), contains but a single species, *Cotyliis nudus* M. & T. = *Lepadogaster nudus* Bl. & Schn. = *Gobiesox gyrinus* Jordan & Evermann, 1896 (not *Cyclotperus nudus* L., a species as yet unrecognized). *Cotyliis* M. & T. (*nudus* = *gyrinus*) is a synonym of *Gobiesox* Lacépède; *fimbriata* therefore requires a new name, as above.

**EPERLANIO** Jordan.

Type: *Osmerus albatrossis* Jordan and Gilbert, the "Kadiak Smelt".

This genus or subgenus differs from *Osmerus* in the very long anal fin of twenty rays. The teeth are much weaker than in *Osmerus*,

though stronger than in *Spirinchus*, the scales smaller, the gill-rakers longer and the lower jaw heavier. *Eperlanus* is an old name of the European smelt, *Osmerus eperlanus* L. It has been already used as a synonym of *Osmerus*. *Eperlanio* is an unused variant.

**ERYTHROCLES** Jordan.

Type: *Erythrichthys schlegeli* Bleeker, the name a substitute for *Erythrichthys* Temminck & Schlegel, preoccupied by *Erythrichthys* Bonaparte (Saggio, 1831), based on *Salmo erythrinus* L. and therefore a synonym of *Erythrinus* (Gronow) Scopoli. *Erythrocles* is one of several very closely related genera, *Emmelichthys* Richardson, *Boxaodon* Guichenot, *Inermia* Poey, *Dipterygonotus* Bleeker and *Plagiogeneion* Forbes, but it seems to be distinct from all of these, whatever their relation to one another.

**EXTRARIUS** Jordan.

Type: *Hybopsis tetranemus* Gilbert.

This genus is distinguished by the presence on each side of two maxillary barbels as in the old-world genus *Barbus*. In other regards it agrees with *Macrhybopsis* Cockerell (*Gobio gelidus* Girard). No other known species of American minnow or chub has more than two barbels.

**IRILLION** Jordan.

Type: *Coregonus oregonius* Jordan and Snyder.

This genus differs from the other offshoots of *Coregonus* in the long sharp nose, firm jaws, and in the very large adipose fin. It frequents mountain streams and is as gamy as a trout. The name is from "the merry wild Irillion rejoicing from fields of snow" of Dunsany's dream world.

**NAUTOPÆDIUM** Jordan.

Type: *Porichthys plectrodon* Jordan & Gilbert = *Batrachus porosis-simus* Cuv. & Val.

This genus is closely allied to *Porichthys* Girard (*notatus*), differing mainly in the palatine dentition. There are but four or five teeth on each palatine, one or two of them developed as a strong canine. In *Porichthys* there are many small palatine teeth, none of them canine-like. The name, *Nautopædium* (ναυτοπαίδιον, sailor-boy), refers to the button-like luminous spots, which have suggested the vernacular name of "Midshipman".

**OSHIKIA** Jordan.

Type: *Micracanthus marcheii* Sauvage.

Name a substitute for *Micracanthus* Sauvage, 1878, preoccupied

by *Microcanthus* Swainson, 1839, a misprint or misspelling of the same word. This name is given in honor of Mr. Masamitsu Oshima, scientific expert of Formosa and author of an admirable memoir (now in press) on the river fishes of Formosa.

**RHEOCLES** Jordan & Hubbs.

Type: *Eleotris sikoræ* Sauvage.

This genus belongs to the *Atherinidæ*, as Dr. Boulenger has suggested. It is characterized by its robust form and its few gill-rakers (about 10), which as figured by Sauvage (*Poissons de Madagascar*) are notably short and thick.

**STYLETOR** Jordan.

Type: *Pisoodonophis cruentifer* Goode & Bean.

This eel, one of the few which burrows into the flesh of fishes, is clearly not a *Pisoodonophis*. "Its peculiar and savage physiognomy due to the constriction of its neck" and the snake-like form of the head with the powerful muscular enlargements of the cheeks distinguish it adequately from the other *Ophichthoid* eels with blunt teeth (σῶλητωρ, a spoiler).

**UNAGIUS** Jordan.

Type: *Cryptophthalmus robustus* Franz (1910).

The name *Cryptophthalmus* is preoccupied in crustacea (Rafinesque, 1812) and in mollusks (Ehrenberg, 1831). *Unagius* may be substituted for it. *Unagi* is the Japanese word for eel.

**UROCLE** Jordan.

Type: *Megalurus lepidotus* Ag. (fossil).

This name is offered as a substitute for *Megalurus* Agassiz, 1833, preoccupied in birds (Horsfield, 1820), and for *Synergus* Gistel (1848), preoccupied in Hymenoptera, both these having the same type.

**VERATER** Jordan.

Type: *Oligopus ater* Risso = *Pteridium atrum* Filippi & Verany.

Substitute for *Pteridium* F. & V., preoccupied by *Pteridium* Scopoli, 1777, which is a substitute for *Pteraclis* Gronow, 1763 and 1772, the use in 1772 unquestionably binomial.

**PNICTES** Jordan.

Type: *Achiropsis asphyxiatus* Jordan & Goss.

This species of sole described from Goyaz, Brazil, differs from *Achiropsis* Steindachner and from all other soles in the complete obliteration of the gill opening of the right or eyed side.

**ERREX** Jordan.

Type: *Glyptocephalus zachirus* Lockington. This species, the "Rex Sole" of the San Francisco fishermen, an excellent food-fish,



differs from *Glyptocephalus* Gottsche, and from all other flounders, in the very long and falcate pectoral fin of the right side, this fin being longer than the head.

**AINIA** Jordan.

Type: *Callopterus agassizi* Thiollière (fossil).

A substitute name for *Callopterus* Thiollière, 1858, preoccupied as *Callopterus* Chaud., 1838, a beetle. The name is from the department of Ain, in France, where the fossil in question was found.

**RAIAMAS** Jordan.

Type: *Cyprinus bola* Hamilton.

A substitute name for *Bola* Günther, 1868, preoccupied by Hamilton. The species, *Raiamas bola* is well known to anglers in India, as "*Rajah mas*".

**TARSISTES** Jordan.

Type: *Rhynchobatis* Philippi, 1858.

A substitute for the latter name, preoccupied as *Rhynchobatus*. The genus is founded on a large ray with a linear, flat, paddle-like snout, rounded at tip somewhat as in *Polyodon* and *Mitsukurina*. Philippi gave to this animal no specific name. It may be called *Tarsistes philippii* (τάρσος, an oar-blade). The type is from the island of Juan Fernandez, off the coast of Chili.

**VIGIL** Jordan.

Type: *Pleurolepis pellucidus* Agassiz.

A substitute for *Pleurolepis* Agassiz, preoccupied in fossil fishes. The type species is placed by Jordan and Evermann in *Ammocrypta*, but *Vigil pellucidus* differs from *Ammocrypta beani* in having the sides of the head scaly, the sides of body largely scaled and the mouth much smaller. The name *Vigil* (on the watch) alludes to the habit of lying motionless, buried in the sand, only the alert eyes being visible.

**ORQUETA** Jordan.

Type: *Micropteryx polycentrus* Kner.

Replaces *Micropus* Kner (S. B. Akad. Wiss. Wein, 1868, p. 28), that name being four times preoccupied; *Orqueta* differs from *Chloroscombrus* Girard in the very much larger number of dorsal spines. The name *Orqueta* is a Spanish vernacular for *Chloroscombrus orqueta* Jordan and Gilbert on the west coast of Mexico.

The following annual reports were ordered to be printed:

#### REPORT OF THE RECORDING SECRETARY.

While the Recording Secretary has been able personally to discharge the duties of his office during the year, he is indebted to the Assistant Librarian, William J. Fox, for indispensable coöperation, for which grateful acknowledgment is due. As was the case last year, the statistics of administration have been prepared by Mr. Fox.

Dr. J. Percy Moore and Dr. Philip P. Calvert have placed the Secretary under obligation by acting as Recording Secretary during the earlier meetings of the Academy and the Council, for which sincere thanks are given. The By-Laws provide for the closing of the academic year with the last of November. Since that period last year meetings have been held on December 18, 1917; January 15th, February 19th, March 19th, April 9th, April 16th and November 16th of the current year.

The meeting of April 9th was held in commemoration of the President, Samuel Gibson Dixon, M.D., LL.D., Sc.D., who died February 2d. Dr. Dixon had been elected a member of the Academy February 25, 1890. He had served as President since 1896. The progress of the society during the twenty-two years which have since elapsed is Dr. Dixon's best memorial. Details of his services to science will be found in the proceedings of the memorial meeting held in April. As a mark of respect to the memory of Dr. Dixon the election of his successor in the presidency was by resolution postponed until the annual meeting.

Communications were made at the meetings during the year by Messrs. Harley Stamp, Philip P. Calvert, James A. G. Rehn, Witmer Stone, Edwin G. Conklin, John Cadwalader, Benjamin F. Royer and Henry Skinner.

In addition to the Proceedings of the Dixon Memorial Meeting papers were presented for publication by Henry A. Pilsbry, F. J. Keeley, Henry W. Fowler, Anna M. Cullen, Janet P. Jameson, Mitchell Carroll, Joseph Hall Bodine, Bruce Wade, James A. G. Rehn and E. G. Vanatta.

The sixteenth volume of the JOURNAL was completed by the publication of a beautifully illustrated paper by Clarence B. Moore on the aboriginal antiquities of Florida.

Three hundred and thirty-seven pages of the PROCEEDINGS were issued with five plates.

The Entomological Section (the American Entomological Society) has published four hundred and thirty-seven pages of the TRANSACTIONS, illustrated by twenty-nine plates. Four hundred pages of the ENTOMOLOGICAL NEWS, illustrated by twenty plates, have been issued.

Parts ninety-six and ninety-seven of the MANUAL OF CONCHOL-OGY, comprising one hundred and eighty-eight pages, have been completed by Dr. Pilsbry and distributed.

Four members and seven correspondents have been elected. Their names are recorded in the PROCEEDINGS as issued.

The deaths of nine members were announced.

Resignation of membership by G. B. Heckel was accepted.

The death of Joseph Willcox, October 1st, deprived the Academy of the services of one who had been interested in the mineralogical work of the society since his election to membership in December, 1867. He had served for years as Custodian of the Isaac Lea collections, a position which he held at the time of his death.

The Ludwick Institute Free Lecture Courses were delivered at the Academy on Mondays, Thursdays and Fridays, January 7th to April 26th, by Witmer Stone, B. Franklin Royer, James A. G. Rehn, Spencer Trotter, Henry A. Pilsbry, J. Percy Moore and J. Fletcher Street. It was necessary early in the year, conforming to government regulations, to change the lectures scheduled for Monday evenings to Thursday evenings. To economize fuel it was also necessary to give a portion of the course in the more easily heated library hall. Ten of the lectures were on the natural history of Philadelphia and vicinity, especially adapted to school-children. The latter were by Messrs. Stone, Moore, Street, Pilsbry and Rehn.

Meetings of the Pennsylvania Audubon Society, the Babies' Welfare Association, and the Philadelphia Pediatric Society were held in the Lecture Hall.

EDWARD J. NOLAN, *Recording Secretary.*

### REPORT OF THE CORRESPONDING SECRETARY.

The following scientific men, all Americans, were elected correspondents: John Henry Comstock, Herbert Spencer Jennings, Frank Rattray Lillie, Alfred Goldsborough Mayor, John Campbell Merriam, George Howard Parker, and Charles Richard Van Hise.

During the course of the year President Charles R. Van Hise and Prof. Samuel W. Williston died. It is probable that the interruption of correspondence with European countries prevented the verification of the reported deaths of others.

Foreign correspondence, which has been steadily decreasing during the progress of the war, fell this year to its lowest ebb.

Invitations were received to participate in the celebration of the semi-centennial of the founding of the Kansas Academy of Science and of the two-hundred-and-fiftieth anniversary of the University of Lund. Prof. Samuel W. Williston was appointed a delegate to the former and a letter of congratulation sent to the latter.

From the Académie des Sciences, Belles-Lettres et Artes de Rouen was received a copy of a resolution passed at a fête held at the Academy on July Fourth expressing admiration for the course, material and moral, taken by the United States and its President "in defense of the Liberty, Law, Justice and Civilization of the World". A letter of similar import was received from Émile Rivirée, a correspondent of the Academy.

Inquiries for information were answered as usual.

Statistics of the correspondence follow:

#### Communications received:

Acknowledging the receipt of the Academy's publications.....	69
Transmitting publications to the Academy.....	30
Requesting exchanges or the supply of deficiencies.....	6
Invitations to learned gatherings, celebrations, etc.....	2
Notices of deaths of scientific men.....	2
Circulars concerning the administration of scientific and educational institutions, etc.....	8
Photographs and biographies of correspondents.....	3
Letters from correspondents }	56
Miscellaneous letters..... }	
Total received.....	176

## Communications forwarded:

Acknowledging gifts to the Library.....	680
Requesting the supply of deficiencies.....	155
Acknowledging gifts to the Museum.....	76
Acknowledging photographs and biographies.....	3
Letters of sympathy or congratulation, addresses, etc.....	5
Diplomas and notices of election of correspondents and delegates' credentials.....	8
Miscellaneous letters.....	121
Annual reports and circulars sent to correspondents.....	14
Total forwarded.....	1,062

Respectfully submitted,

J. PERCY MOORE, *Corresponding Secretary.*

## REPORT OF THE LIBRARIAN.

The efficient services reported last year as having been rendered during the concluding months of 1917 by the Assistant Librarian, William J. Fox, have been continued and the growth of the library represented by the following report is the result:

The total additions amount to 4,503, consisting of 4,061 pamphlets and parts of periodicals, 293 volumes, 148 maps and one framed portrait.

They were received from the following sources:

Exchanges.....	2,024	James Aitken Meigs Fund.....	8
Isaiah V. Williamson Fund....	1,209	United States Department of Commerce and Labor.....	8
United States Department of Agriculture.....	688	Vermont Agricultural Experi- ment Station.....	8
General Appropriation for the Purchase of Books.....	88	New York State Board of Charities.....	8
Authors.....	62	Carleton College.....	7
Pennsylvania State Library....	56	Thomas B. Wilson Fund.....	6
United States Department of the Interior.....	54	Mrs. Samuel G. Dixon.....	6
Editors.....	40	South Dakota School of Mines	6
American Entomological Society	30	Edward J. Nolan.....	6
Imperial Department of Agri- culture of the British West Indies.....	22	Publication Committee of the Academy.....	5
Trustees of the British Museum	16	Commission of Conservation, Canada.....	5
New York Agricultural Experi- ment Station.....	15	Dr. Henry Skinner.....	5
Samuel G. Gordon.....	12	Queensland Department of Mines.....	4
Secretaria de Agricultura y Fomento, Mexico.....	11	Indiana University.....	4
California State Commission of Horticulture.....	9	United States War Department	3
Cuerpo de Ingenieros de Minas del Peru.....	9	Government of India.....	3
Water Supply Commission of Pennsylvania.....	9	Witmer Stone.....	3
Utah Agricultural College Ex- periment Station.....	8	Department of Conservation and Development, New Jersey...	3
		California Fish and Game Com- mission.....	3
		Department of Fisheries, Bengal, Bihar and Orissa.....	2

University of Wyoming.....	2	William J. Fox.....	1
National Academy of Sciences..	2	Delaware Valley Ornithological	
Geological Survey of Georgia..	2	Club.....	1
New South Wales State Fish-		Estacion Sismologica de Car-	
eries.....	2	tuja.....	1
Canada Department of the In-		Iowa Geological Survey.....	1
terior.....	2	New York Archeological Asso-	
Lowell Observatory.....	2	ciation.....	1
American Iron and Steel In-		Commissioners of Fisheries and	
stitute.....	2	Game, Massachusetts.....	1
Escola Superior de Agricultura		Zoological Society of Philadel-	
e Medicina Veterinaria, Pin-	2	phia.....	1
heiro.....	2	Mechanics' Institute, San Fran-	
Michigan Geological and Bio-		cisco.....	1
logical Survey.....	2	Scientific Society of San An-	
Nova Scotia Department of		tonio.....	1
Agriculture.....	2	J. B. Haines.....	1
Roger Williams Park Museum	2	Government of Formosa.....	1
Florida State Geological Survey	2	Hawaiian Entomological Society	1
W. L. Abbott, M.D.....	2	D. J. Bullock.....	1
Louisiana State Museum.....	1	Department of Trade and Cus-	
Pan-American Union.....	1	tons, Australia.....	1
Clarence B. Moore.....	1	Los Angeles County Museum	
Illinois State Mining Board....	1	of Natural History and Art..	1
Universidad Nacional, Mexico..	1	Argentine Government.....	1
Board of Water Supply, New		Instituto de Butantan.....	1
York City.....	1	Art and Museum Commission-	
Observatorio de Madrid.....	1	ers, Grand Rapids.....	1
Colorado Museum of Natural		Department of Marine and	
History.....	1	Fisheries, Canada.....	1
Philip P. Calvert.....	1	St. Louis Natural History Mu-	
Scripps Institution for Biological		seum Association.....	1
Research.....	1		

They have been distributed to the various departments of the library as follows:

Journals.....	2,858	Physical Science.....	11
Agriculture.....	754	Ichthyology.....	11
Geology.....	373	Mammalogy.....	9
Geography.....	145	Conchology.....	8
Botany.....	118	Medicine.....	8
General Natural History.....	37	Mathematics.....	7
Entomology.....	25	Chemistry.....	5
Voyages and Travels.....	20	Herpetology.....	3
Mineralogy.....	19	Bibliography.....	2
Anatomy and Physiology.....	17	Helminthology.....	2
Ornithology.....	15	Philology.....	1
Anthropology.....	11	Miscellaneous.....	44

The following journals are new to the library:

American Anatomical Memoirs. Philadelphia.  
 Art and Museum Commissioners, Grand Rapids. Annual Report.  
 Biochemical Journal. London.  
 Biological Board of Canada. Bulletin.  
 Brooklyn Botanic Garden. Memoirs.  
 Escola Superior de Agricultura e Medicina Veterinaria, Pinheiro. Archives.  
 Geographic Society of Chicago. Publications.  
 Illinois Natural History Society. Transactions.  
 Instituto de Butantan. Collectanea de Trabalhos, 1901-17.

Instituto Geologico de Espana. *Memorias*.  
International Journal of American Linguistics. New York.  
Journal of General Physiology. Baltimore.  
Journal Russe de Zoologie. Petrograd.  
Junta de Ciencias Naturals de Barcelona. *Publicacions. Series Geologica*.  
Kansas Academy of Science. *Bulletin*.  
Kgl. Danske Videnskabernes Selskab. *Biologiske Meddelelser, Mathematisk-fysiske Meddelelser*.  
Laboratorio de Plasmogenia de la Habana. *Boletin*.  
Madison Botanical Congress. *Proceedings, 1893*.  
New York State Archeological Association, Morgan Chapter. *Researches and Transactions*.  
New Zealand Journal of Science and Technology. Wellington.  
Pan American Record. Los Angeles.  
Royal Geographical Society. *Supplement of the Geographical Journal*.  
St. Louis Natural History Museum Association. *Bulletin*.  
Societa Italiana dei Microscopisti. *Bollettino*.  
Soil Science. New Brunswick, N. J.  
South African Institute for Medical Research. *Publications*.  
South Australia Director of Mines and Government Geologist. *Annual Report*.  
South Australian Museum. *Records*.  
Staten Island Institute of Arts and Sciences. *Museum Bulletin*.

Twelve hundred and twenty-five volumes and parts of periodicals were used on the premises, while 59 volumes were borrowed.

Four hundred and thirty-three volumes have been bound.

The resignation of Furman S. Wilde as Assistant to the Librarian was accepted. He has since been serving with the army in France.

Five hundred and nine serials and twenty-two volumes have been returned to the Superintendent of Public Documents, Washington.

The continued coöperation of Miss Wardle in library service is gratefully acknowledged.

EDWARD J. NOLAN, *Librarian*.

#### REPORT OF THE CURATORS.

The past year, on account of unprecedented conditions incident to the war, has not been one in which any important work outside the usual routine of the museum has been possible. Fuel restrictions have prevented the heating of the public halls and during certain days necessitated the closing of the work-rooms. One of our janitors left our employ early in the year and in order to meet additional expenses elsewhere we have managed to avoid the necessity of filling this position. The absence of several volunteer workers during most of the year, and of Mr. Rehn for several weeks, all on work connected with the war has hindered the progress of research work to some extent, while the serious illness of Dr. Skinner has kept him from his office for over two months. Notwithstanding these hindrances, however, the Curators feel that they may con-

gratulate themselves upon having been able to maintain the usual Museum activities without any detriment to the collections or their arrangement during these trying times.

Early in the summer a competent steam engineer was engaged to examine the entire heating plant and to draw up plans for remedying serious defects in the present system as well as for the installation of new boilers. We were fortunate enough to secure two Spencer boilers, which have been placed in the engine house and have already proved very satisfactory, although some of the repiping is still unfinished. The expense of these important improvements is covered by an appropriation made at the last session of the State Legislature and referred to in our last report.

The falling of certain sections of plaster ceiling has necessitated the removal of all the ceiling covering in the mineralogical hall, with the intention of substituting a sheet metal ceiling at the earliest opportunity.

Additional exhibits have been added to the collection of native trees, to the local collection of birds and nests presented by the Delaware Valley Ornithological Club, to the Clarence B. Moore collection of Indian antiquities and to the William S. Vaux collection of minerals.

Numerous classes of school-children have visited the Museum during the year and various duplicate specimens, especially sets of labelled minerals, have been presented to schools in Philadelphia and vicinity.

During the year Dr. Skinner made some important entomological collections in the White Mountains of New Hampshire.

Dr. Stone spent several weeks in making an exhaustive collection of the flora of southern Cape May County, N. J., and some local field work was carried on by other members of the Museum staff. Mr. Clarence B. Moore has also continued his explorations of the Indian mounds of the Southern States and presented the Academy with valuable material. Details of work in the several departments follow.

#### MAMMALS.

A number of valuable specimens received from the Zoölogical Society of Philadelphia have been prepared as skins or skeletons, while a large number of skeletons and skulls previously prepared in the rough have been macerated, numbered and placed in the study series. This work was carried on by the taxidermist, Mr. David McCadden. Besides entering accessions the entire register of the



Rhoads collection, numbering 4,390 entries, has been copied into the regular mammal catalogue.

Specimens have been loaned during the year to Dr. J. A. Allen and Mr. A. H. Howell.

#### BIRDS.

A number of accessions to the local collection have been placed on exhibition and much of the collection rearranged and relabelled. The services of Miss Ruth Faries were secured during nine months of the year and much needed clerical work was accomplished. Several temporary catalogues were copied into the regular Academy register, including that of the Hoopes collection, making a total of some 14,000 entries. In addition new labels were prepared for all the skins of the lower families of Passeres in the study collection, as well as of the Tanagridæ and most of the Fringillidæ.

The eggs in the Pennock collection and many of those in the Drown collection were placed in glass-covered boxes and catalogued, while many unmounted specimens of birds were converted into skin specimens.

Dr. Stone, although mainly occupied with the executive duties of the Museum, revised several of the families in the study collection and prepared a report on the Jewel collection of Panama birds, which has been published in the PROCEEDINGS.

The most notable accessions received during the year were the Mrs. W. A. Drown collection of bird eggs and mounted birds, and a collection of Colombian birds obtained by purchase.

Dr. H. C. Oberholser, Mr. W. E. C. Todd, Mr. Edwin Ashby and Mr. F. H. Kennard have made use of the collections, while specimens have been loaned to Mr. Todd, Mr. C. B. Cory and Dr. C. W. Richmond.

#### REPTILES AND FISHES.

Mr. Henry W. Fowler, who has had charge of the fishes as well as of the reptiles, reports that 1,783 fishes have been received during the year, which have all been catalogued and labelled. He has also critically identified some 400 species of fishes. These comprised specimens in the Academy collection from Brazil, Panama, the West Indies and Australia as well as our entire series of African fishes and a collection from Samoa loaned by Capt. C. F. Silvester, from which the Academy will receive duplicates.

Two papers were published in the PROCEEDINGS on Philippine fishes and on a collection received from Paraguay. Progress was

made on the critical study of the series of flying fishes, half-beaks and green gars.

General care of the collections (both of fishes and reptiles) has occupied considerable time, necessitating the rebottling and cleansing of many specimens.

Mr. Fowler did some field work in Perry County, Pa., and Cape May Co., N. J. Specimens of reptiles were loaned during the year to the American Museum of Natural History. Mr. Alex. Ruthven, Dr. Thomas Barbour, Mr. F. N. Blanchard and Mr. Alvin Seal spent some days in studying material at the Academy.

#### MOLLUSKS.

Dr. Henry A. Pilsbry, curator of Mollusca, reports that accessions to the conchological department have been received from sixty-seven persons and institutions. Among them may be mentioned a series of Congo mollusks from the American Museum of Natural History, including paratypes of many new species, and a considerable number of Hawaiian mollusks received from the Bishop Museum and from Prof. W. A. Bryan. Mr. J. H. Ferriss shared his Arizona collections of 1917 and 1918 with the Academy and Prof. Junius Henderson has presented series of his Idaho and Colorado collections.

The revision of the Academy collection of Pupillidæ has been continued in connection with the publication of a second volume on this group in the Manual of Conchology. In collaboration with Mr. Ferriss a report on the mollusks of the Santa Catalina mountains and the Mogollon mountains, Arizona, has been prepared for publication. Mr. E. G. Vanatta has continued the arrangement of the exhibition series of shells and Miss Caroline Ziegler has made good progress in cataloguing the specimens. Considerable time has been given to the determination of material for correspondents.

Mr. J. A. Ferriss, W. H. Clapp and Edwin Ashby have spent some time in studying in the department during the year, and specimens were loaned to Mr. E. P. Chase, Dr. Paul Bartsch and Mr. J. B. Henderson. Mr. R. T. Jackson also borrowed some fossil mollusca.

#### INSECTS.

The department of Entomology has had the usual care and attention given to it by those in charge. Dr. Henry Skinner and Mr. E. T. Cresson, Jr., have looked after all the orders except the Orthoptera, which have had the attention of Mr. J. A. G. Rehn. The

accessions for the year amount to 2,953 specimens, most of which have been incorporated in the collection.

A number of families have been rearranged: the Scarabæidæ, Rhipiphoridæ, Stylopidæ, Cleridæ, Malachidæ, Meloidæ and Buprestidæ in the Coleoptera; the Scathophagidæ, Sepsidæ and Ephydridæ in the Diptera, and the large series of exotic Noctuidæ among the Lepidoptera. Some valuable material in the last order collected by Dr. Skinner in the White Mountains of New Hampshire was incorporated in the collection. In the order Hemiptera the family Cicadidæ has been rearranged in accordance with identifications made by Mr. Wm. T. Davis, and in the Hymenoptera the H. L. Viereck types of *Andrena* have been placed in the type series.

In the Orthoptera besides the mounting and rearrangement of material, studies have been made of an extensive series of Brazilian material and three papers prepared and published upon it. A study has also been made of our African material as well as of several African collections loaned for identification, of which the Academy will receive a series of duplicates. A paper was also published in the PROCEEDINGS on the North American Eumastæinæ, while correspondence by Mr. Rehn has resulted in the receipt of valuable material in return for determination.

Several visiting entomologists, especially Dr. E. C. Van Dyke, have made use of the collections and material has been loaned to J. R. Malloch, J. S. Hine and R. W. Dawson.

#### PLANTS.

Mr. Stewardson Brown, who has had charge of the herbarium, reports that during the year the herbarium of the late Charles S. Williamson, presented by his sister Miss Mary Williamson, has been distributed throughout the herbarium so that the specimens are now readily accessible with the other material. The J. J. Carter herbarium, the gift of Mr. H. S. Gatchell, has been in a great part mounted ready for stamping and distribution. Numerous other collections received from various sources have been mounted by Miss Ada Allen, who has been continued as an aid in this work.

The local collection has received considerable attention from Mr. S. S. Van Pelt, who has mounted many specimens that have been received. Mr. Bayard Long has also given the collection considerable critical study.

#### MINERALS AND ROCKS.

The Curators are indebted to Mr. F. J. Keeley, Curator of the William S. Vaux collection, and to Mr. Samuel G. Gordon, a student

on the Jessup Fund, for the care of this department. Mr. Gordon has labelled and catalogued a number of accessions to the Wm. S. Vaux and the general collections and prepared a check list of the entire series. The William S. Vaux collection now numbers about 9,000 specimens, nearly half of which are on exhibition; the Academy general series, 10,500 specimens, of which about 1,000 are exhibited, and the Adam Seybert collection, which is kept separate, 1,825 specimens, while there are 80 falls of meteorites represented.

The duplicate specimens not on exhibition are arranged systematically in storage cases immediately below the exhibition series so that they may be consulted with the greatest ease.

Mr. Gordon has overhauled a large number of mineral and rock specimens received at various times and cleaned and labelled such as are of value. The rock series now in the Academy's possession, including the first and second Pennsylvania Geological Survey collections, amounts to about 19,000 specimens.

The most important accession during the year was the Mrs. W. A. Drown collection, presented by Miss Emily Drown, comprising some 6,000 specimens. It was especially notable for the large number of species represented, a number of which were new to our collection.

#### ARCHÆOLOGY.

Miss H. N. Wardle has overhauled several thousand specimens mostly belonging to the Haldemann collection, which were stored in the basement, and has cleansed and identified them, entering some 2,000 in the catalogue. Little new material was obtained during the year.

Mr. Clarence B. Moore's expedition during the spring of 1918 explored territory along the Apalachicola River, the Flint River to Bainbridge, Ga., and the Florida coast from St. Andrew's Bay to Crystal River. The result demonstrated how thorough had been his earlier exploration of the same region, as little new material was obtained. Pottery and artifacts regarded as duplicates were presented by Mr. Moore to the Museum of the American Indian, Heye Foundation. Owing to necessary repairs to his boat Mr. Moore was compelled to abandon his usual autumn expedition.

Throughout the year the undersigned Curators have been without the advice and counsel of their associate Maj. Henry Tucker, who since the entry of America into the war has been in the service of his country in the medical corps of the Army.

WITMER STONE, *Chairman*,  
HENRY A. PILSBRY.

REPORT OF THE CURATOR OF THE WILLIAM S. VAUX COLLECTIONS,  
DECEMBER 1, 1918.

Efforts during the past year, in the direction of securing as many rare and unusual species as possible, have resulted in the addition of no less than 127 species not hitherto represented in the William S. Vaux collection, of which number 87 were purchased and 40 selected from the Drown collection.

This brings the total number of distinct species in the collection up to 804, not including meteorites, hydrocarbons, varieties or doubtful species.

Altogether the number of accessions during the year exceeded 800, of which 104 were purchased, 700 derived from the Drown collection, 3 presented by Mr. Thomas Harvey and 3 presented by Mr. Samuel G. Gordon, who has continued his valuable services in caring for the collection.

Respectfully submitted,

F. J. KEELEY, *Curator Wm. S. Vaux Collection.*

## REPORTS OF THE SECTIONS.

BIOLOGICAL AND MICROSCOPICAL SECTION.—The Section held six stated meetings during the year, a reduction of the usual number due to war regulations and the influenza epidemic.

Communications on various subjects were made by members, among whom may be mentioned Messrs. T. C. Palmer, Hugo Bilgram, Dr. Thomas S. Stewart, F. J. Keeley, B. F. Ray, Walter Palmer, Dr. L. A. Faught and C. S. Boyer.

The following officers were elected for the year 1919:

*Director*.....J. Cheston Morris, M.D.

*Vice-Director*.....T. Chalkley Palmer.

*Recorder and Corresponding Secretary*..Charles S. Boyer.

*Treasurer*.....Thomas S. Stewart, M.D.

*Conservator*.....F. J. Keeley.

CHARLES S. BOYER, *Recorder.*

ENTOMOLOGICAL SECTION.—Six stated meetings were held during the year, with an average attendance of eleven persons. The deaths of Erich Daecke, a contributor, and Benjamin H. Smith, a member, were announced. Arthur H. Napier and George M. Greene were elected members, and Francis M. James, Louis B. LaPlace, Carl Lorup, A. Reginald Allen and Max Reyher were elected con-

tributors. Interesting communications were made by R. C. Williams, Jr., J. A. G. Rehn, P. P. Calvert, Henry Skinner, Philip Laurent, Herman Hornig, Dr. P. W. Whiting, and Dr. J. Bequaert.

The following officers and committee were elected to serve for 1919:

<i>Director</i> .....	Philip Laurent.
<i>Vice-Director</i> .....	R. C. Williams, Jr.
<i>Treasurer</i> .....	E. T. Cresson.
<i>Conservator</i> .....	Henry Skinner.
<i>Secretary</i> .....	J. A. G. Rehn.
<i>Recorder</i> .....	George M. Greene.
<i>Publication Committee</i> .....	E. T. Cresson, Philip P. Calvert, E. T. Cresson, Jr.

E. T. CRESSON, JR., *Recorder*.

**BOTANICAL SECTION.**—The following officers were elected to serve during the year 1919:

<i>Director</i> .....	Joseph Crawford.
<i>Vice-Director</i> .....	Alexander MacElwee.
<i>Recorder</i> .....	John W. Eckfeldt, M.D.
<i>Treasurer</i> .....	Stewardson Brown.
<i>Conservator</i> .....	Stewardson Brown.

JOHN W. ECKFELDT, M.D., *Recorder*.

**MINERALOGICAL AND GEOLOGICAL SECTION.**—The Section held four meetings, with the usual attendance. Prof. Wright discussed the topography of the upper James River; there were also discussions of peat growth, and of Tertiary coal. Other mineralogical and geological matters were discussed.

The Section made six field excursions with an average attendance of eleven. The excursions were not formally announced, but were orally noted. The excursions were all in the crystalline region of Delaware County, except one in that of the Gulph region of Montgomery County.

The deaths of Prof. Carter, Mr. Schumo, Mr. DuBois and Joseph Willcox were announced. They were active members of the Section, and particularly interested in the field excursions. Mr. DuBois was for many years an efficient member of the excursion committee.

The officers elected for the coming year are:

<i>Director</i> .....	Benjamin Smith Lyman.
<i>Vice-Director</i> .....	F. J. Keeley.
<i>Recorder and Secretary</i> .....	Wm. B. Davis.
<i>Treasurer</i> .....	Benjamin Smith Lyman.
<i>Conservator</i> .....	George Vaux, Jr.

BENJAMIN SMITH LYMAN, *Director*.

ORNITHOLOGICAL SECTION.—The Section has done much to encourage ornithological activity at the Academy during the year. The meetings of the Delaware Valley Ornithological Club and Pennsylvania Audubon Society have been held in the building and have helped to stimulate interest in this department of the Academy.

At the annual meeting of the Section the following officers were elected for the year 1919:

<i>Director</i> .....	Spencer Trotter, M.D.
<i>Vice-Director</i> .....	George Spencer Morris.
<i>Recorder</i> .....	Stewardson Brown.
<i>Secretary</i> .....	William A. Shryock.
<i>Treasurer and Conservator</i> .....	Witmer Stone.

WITMER STONE, *Conservator*.

The annual election of Officers, Councillors and members of the Committee on Accounts was held December 17th, with the following result:

PRESIDENT.....	John Cadwalader, A.M., LL.D.
VICE-PRESIDENTS.....	Edwin G. Conklin, Ph.D., Sc.D., Henry Skinner, M.D., Sc.D.
RECORDING SECRETARY.....	Edward J. Nolan, M.D., Sc.D.
CORRESPONDING SECRETARY.....	J. Percy Moore, Ph.D.
TREASURER.....	George Vaux, Jr.
LIBRARIAN.....	Edward J. Nolan, M.D., Sc.D.
CURATORS.....	Witmer Stone, A.M., Sc.D., Henry A. Pilsbry, Sc.D., Henry Tucker, M.D., Spencer Trotter, M.D.
COUNCILLORS TO SERVE THREE YEARS.....	Philip P. Calvert, Ph.D., Frank J. Keeley, Walter Horstmann, T. Chalkley Palmer.

COMMITTEE ON ACCOUNTS.....Charles Morris,  
 Samuel N. Rhoads,  
 John G. Rothermel,  
 Thomas S. Stewart, M.D.,  
 Walter Horstmann.

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COUNCIL FOR 1919.

*Ex-Officio*.—John Cadwalader, A.M., LL.D., Edwin G. Conklin,  
 Ph.D., Sc.D., Henry Skinner, M.D., Sc.D., Edward J. Nolan,  
 M.D., Sc.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry  
 A. Pilsbry, Sc.D., Witmer Stone, A.M., Sc.D., Henry Tucker,  
 M.D., Spencer Trotter, M.D.

*To serve three years*.—Philip P. Calvert, Ph.D., Frank J. Keeley,  
 Walter Horstmann, T. Chalkley Palmer.

*To serve two years*.—Charles P. Penrose, M.D., LL.D., Ph.D., Charles  
 Morris, Wm. E. Hughes, M.D., Spencer Trotter (elected Curator).

*To serve one year*.—Edwin S. Dixon, Robert G. LeConte, M.D.,  
 George Spencer Morris, Henry Skinner, M.D. (elected Vice-Presi-  
 dent).

COUNCILLOR.....George Vaux, Jr.

CURATOR OF MOLLUSCA.....Henry A. Pilsbry, Sc.D.

CURATOR OF WILLIAM S. VAUX COL-

LECTION.....Frank J. Keeley.

ASSISTANT LIBRARIAN.....William J. Fox.

ASSISTANTS TO CURATORS.....Henry Skinner, M.D., Sc.D.,  
 Stewardson Brown,  
 Edward G. Vanatta,  
 Henry W. Fowler,  
 James A. G. Rehn,  
 Ezra T. Cresson, Jr.

AID IN ARCHAEOLOGY.....Harriet Newell Wardle.

AID IN HERBARIUM.....Ada Allen.

*Taxidermist*.....David McCadden.

*Janitors*.....Charles Clappier,  
 Daniel Hechler,  
 Jacob Aebly,  
 Adam E. Hechler.

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STANDING COMMITTEES, 1919.

FINANCE.—Effingham B. Morris, John Cadwalader, A.M., LL.D.,  
 Edwin S. Dixon, Walter Horstmann, and the Treasurer.



PUBLICATION.—Henry Skinner, M.D., Sc.D., Witmer Stone, A.M., Sc.D., Henry A. Pilsbry, Sc.D., William J. Fox, Edward J. Nolan, M.D., Sc.D.

LIBRARY.—Henry Tucker, M.D., George Vaux, Jr., Frank J. Keeley.

INSTRUCTION AND LECTURES.—Henry Skinner, M.D., Sc.D., Henry A. Pilsbry, Sc.D., Charles Morris, James A. G. Rehn, George S. Morris.

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### ELECTIONS IN 1918.

#### MEMBERS.

*January 15.*—Andrew J. Carty, Annabella E. Richards, Ph.D.

*March 19.*—Francis R. Cope.

*April 16.*—Geo. M. Greene.

#### CORRESPONDENTS.

*March 19.*—John Henry Comstock of Ithaca, N. Y.; Herbert Spencer Jennings of Baltimore, Frank Rattray Lillie of Chicago, Alfred Goldsborough Mayor of Princeton, N. J., John Campbell Merriam, Ph.D., of Berkeley, Cal., Geo. Howard Parker, Sc.D., of Cambridge, Mass., Charles Richard Van Hise, Ph.D., LL.D., of Madison, Wis.

## ADDITIONS TO THE MUSEUM.

1918.

## MAMMALS.

DR. J. P. MOORE. Skin and skull of New York Weasel (*Putorius noveboracensis*), Delaware Co., Penna.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens prepared in the following manner: For mounting (skulls separate): Lion (*Felis leo*) ♂. Indian Antelope (*Antilope cervicapra*) ♂. As skin and skeleton: Orang-utan (*Pongo pygmaeus*). Wild Horse (*Equus przewalskii*) ♀. As skeleton: Warthog (*Phacochoerus africanus*). Indian Tapir (*Tapirus indicus*). As skin and skull: Pinché Marmoset (*Edipomidas aedipus*). Texan Eyra Cat (*Felis cacomilli*). Fishing Cat (*Felis viverrina*). Binturong (*Arctitis binturong*). Thibetan Blue Bear (*Ursus pruinosus*). Sun Bear (*Helarctos malayanus*). Sloth Bear (*Melursus labiatus*). Mexican Raccoon (*Procyon lotor hernandezi*). Common Duiker (*Cephalophus grimmii*). Indian Antelope (*Antilope cervicapra*) ♀. Audad (*Ovis tragelaphus*) young. Coypu Rat (*Myopotamus coypu*). Common Dasyure (*Dasyurus maculatus*). Squirrel-like Phalanger (*Petaurus sciureus*). As skulls: Mandrill Baboon (*Papio mormon*) ♀. Woolly Spider Monkey (*Brachyteles arachnoides*). Humboldt's Woolly Monkey (*Lagothrix lagotricha*). Steller's Sea-lion (*Eumetopias stelleri*). Cape Hyrax (*Procavia capensis*). Lund's Opossum (*Didelphis albiventris*).

## BIRDS.

HENRY S. BISSEX. Collection of mounted birds.

MISS EMILY DROWN. Mrs. W. A. Drown's collection of birds' eggs and mounted birds.

J. W. HOLMAN. Two Barred Owls (*Syrnium nebulosum*), West Creek, N. J.

MRS. L. H. PARKS. Collection of North American birds' eggs.

MRS. FRANK SARACOO. Mounted Short-eared Owl (*Asio accipitrinus*).

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens prepared as follows: As skin and skeleton: Black-footed Penguin (*Spheniscus demersus*). As skeleton: Somaliland Ostrich (*Struthio molybdophanes*). As skin: Black Vulture (*Catharista urubu*). As skulls: Canvas-back Duck (*Marila valisineria*). Upland Goose (*Loephaga magellanica*). Crested Curassow (*Crax allector*). Golden Eagle (*Aquila chrysaetos*). Brazilian Caracara (*Polyborus tharus*). Barn Owl (*Aluco pratincola*).

## REPTILES AND AMPHIBIANS.

A. DE W. BERTONI. Small collection of reptiles and amphibians. Puerto Bertoni, Paraguay.

DR. HENRY FOX. Two toads (*Scaphiopus holbrooki*) and one salamander. Clarksville, Tenn.

PHILIP LAURENT. Skink (*Eumeces lineatus*). Gunntown, Fla.

## FISHES.

H. W. AITKEN. Small collection of fishes. Connecticut and Florida.

A. DE W. BERTONI. Small collection of fishes. Puerto Bertoni, Paraguay.

SAMUEL C. CASTNER. Two specimens of Remora (*Leptecheneis naucrates*). Cape May, N. J. Rabbit fish (*Lagocephalus laevigatus*). Cape May, N. J.

FIELD MUSEUM OF NATURAL HISTORY. (By exchange). Thirty-four Atherine fishes.

MUSEUM OF COMPARATIVE ZOOLOGY. (For determination). Ninety-two loaches and three hundred and ninety-two cyprinoid fishes. India.

PHILADELPHIA COMMERCIAL MUSEUM. Large collection of fishes. Philippine Islands. Many interesting additions to the Academy's collection.

C. T. RAMSDEN. Jar of *Domilator maculatus* (Bloch). Guantanamo, Cuba.

#### INSECTS.

S. F. AARON. Two katydids, Berks County, Pennsylvania.

W. L. ABBOTT. Three insects, North Carolina.

C. P. ALEXANDER. Twenty crane-fly larvæ, United States.

W. L. McATEE. Fifteen Psyllidæ, United States.

ANNETTE F. BRAUN. Thirty-eight Microlepidoptera, Ohio.

B. PRESTON CLARK. Twenty-five *Argynnis*, Asia and Africa.

T. D. A. COCKERELL. Fifteen exotic bees. Six fossil insects, one Coccid.

W. J. COXEY. Two moths, Assam.

R. W. DAWSON. Three *Serica*, United States.

W. T. DAVIS. One Orthopteron, Florida.

EMILY DROWN. Large collection of Lepidoptera.

EXCHANGE. Two *Calocala tilonia*, Missouri.

EXCHANGE. Two hundred Ephydridæ.

J. H. FERRISS. Five Acrididæ, Arizona.

H. FOX. Fifty-five Orthoptera, Tennessee.

J. M. GEDDES. One hundred and twelve insects, British Guiana.

G. M. GREEN. Eight Meloids, Virginia; four Orthoptera, Maryland; two Diptera, United States.

WAGNER GREEN. Eight Coleoptera, United States.

MORGAN HEBARD. Six Blattidæ, Colombia; two Acrididæ, California.

FRANK M. JONES. Forty-one Orthoptera, United States.

H. H. KNIGHT. Thirty-five Hemiptera, United States.

PHILIP LAURENT. Three Orthoptera, Florida.

CHARLES LIEBECK. One Earwig, Canada.

WERNER MARCHARD. Four Orthoptera and Hemiptera, United States.

J. P. MOORE. One Hymenopteron, Utah.

ROBERT K. NABOURS. Five Acrididæ, Texas and Mexico.

J. K. PRIMM. Two Coleoptera, New Jersey.

PURCHASED. Five hundred and seventy-five Orthoptera, Madagascar.

HENRY SKINNER. Three moths, Florida; thirty insects, New Hampshire.

#### RECENT MOLLUSCA.

DR. W. L. ABBOTT. Forty trays of shells from Haiti and Tennessee.

J. AEBLY. Three lots of marine shells from Greece.

ALABAMA MUSEUM OF NATURAL HISTORY. Two trays of *Lepyrium*.

C. C. ALLEN. Fifty-seven shells from Southeast United States.

AMERICAN MUSEUM EXPEDITION. Seventy African land shells.

CHARLES H. BAKER. Four lots of shells from Florida.

F. C. BAKER. *Amnicola clarkei* Pils. from Oneida Lake, New York.

DR. FRED BAKER. *Tethys californica* Cooper from La Jolla, California.

E. B. BARTRAM. Five trays of shells from Florida.

DR. JOSEPH BEQUAERT. Two hundred and seventy-seven trays of shells from Europe and Africa.

BERNICE PAUAAHI BISHOP MUSEUM. Thirty-eight lots of *Lyropupa* from the Hawaiian Islands.

S. S. BERRY. Four trays of shells from California and Wyoming.

LOUIS H. BREGY. *Meretrix petechialis* Lam.

PROF. W. A. and E. J. BRYAN. One hundred and ninety-six trays of Hawaiian shells.

E. P. CHACE. Five marine shells from California.

ASA C. CHANDLER. Eight lots of fresh water shells from Oregon.

DR. A. W. CHEEVER. Six trays of New England shells.

G. H. CLAPP. *Liguus solidus* Say from Big Pine Key, Florida.

W. F. CLAPP. Ten trays of land shells from the Philippine Islands and North America.

T. D. A. COCKERELL. Eleven trays of shells from New Mexico.

EMILY COLLINS COLLECTION. *Epitonium pretiosa* Lam.

PH. DAUTZENBERG. Four African land shells.

C. B. DEHAVEN. Twelve marine shells from California.

MISS EMILY DROWN. Four trays of shells.

DR. FLORENTINO FELIPPONE. Two *Mytilus* from South America.

J. H. FERRISS. Three hundred and seventeen trays of shells from southwestern United States.

J. H. FERRISS and L. E. DANIELS. Thirty-five trays of land shells from Arizona and New Mexico.

G. M. GREENE and F. HOMER. *Planorbis corneus rubra* B. from an aquarium in Philadelphia, Pennsylvania.

D. L. BREWER HALL COLLECTION. Thirty-five lots of shells.

J. B. HENDERSON. Seven lots of *Dentalium* from Florida and Cuba.

JUNIUS HENDERSON. Ninety-eight trays of shells from Colorado and Idaho.

A. JACOT. Three land shells from Ithaca, New York.

L. A. KEENE. Eight species of *Unionida* from Illinois.

C. H. KNOWLTON. Two land shells from Vermont.

MRS. A. F. LETSON. Five marine shells from the Hawaiian Islands.

O. S. LEWIS. Four trays of shells from Tennessee, Virginia and Indiana.

BAYARD LONG. Nineteen trays of shells from the Eastern United States.

DR. HENRY LOOMIS. Four hundred and forty-seven lots of Japanese shells (purchased).

H. N. LOWE. Thirty-seven land and marine shells from California.

J. G. MALONE. Three slugs from Oregon.

E. H. MATTHEWS. Four Australian marine shells.

REV. H. E. MEYER. Twenty-two trays of shells.

CLARENCE B. MOORE. Nine trays of shells from Florida.

DR. J. P. MOORE. Two fresh water shells from Utah.

MRS. IDA S. OLDROYD. Ten lots of shells from Western America.

C. R. ORCUTT. Three trays of shells from Texas.

DR. H. A. PILSBRY. Twenty-seven lots of shells from Arizona and the Hawaiian Islands.

DR. H. A. PILSBRY and J. H. FERRISS. Seven trays of Arizona shells.

E. J. POST. Three species of shells from Canada.

PURCHASED. Sixty-three species of land shells.

CLARE W. RAVENEL. Twenty-one species of marine shells from Florida.

DR. EMMET RIXFORD. *Micrarionta wolcottiana* Bart. from Palm Springs, California.

S. RAYMOND ROBERTS. *Corbula contracta* Say from off Nantucket Shoals, Massachusetts.

MARIANO S. ROIG. Sixty-two Cuban marine shells.

C. HENRY RONEY. *Crepidula fornicata* L.

ESTATE DR. B. SHARP. Three lots of shells.

H. H. SMITH. Three land shells from Tennessee.

LLOYD B. SMITH. Twelve land shells from Haiti.

DR. V. STERKI. Four trays of North American land shells.

J. K. STRECKER, JR. Five lots of shells from Texas.

MRS. MARY LUDWIG SUYDAM. Collection of marine shells.

D. THAANUM. Two Hawaiian marine shells.

E. G. VANATTA. Five trays of shells.

BRYANT WALKER. Six lots of shells from Texas and Canada.

MRS. NINA WINCHESTER. Eighty marine shells from the Philippine Islands.

#### OTHER INVERTEBRATES.

H. W. AITKEN. Several crabs, Connecticut and Florida.

EMILY COLLINS COLLECTION. A barnacle and coral.

C. B. DE HAVEN. *Chthamalus fissus* Dar. from Santa Barbara, California.

DR. FLORENTINO FELIPPONE. Two lots of *Balanus niveus* Dar. from South America.

H. E. HUBERT. *Balanus improvisus* D. from Lake Pontchartrain, Louisiana.

PHILIP LAURENT. Small collection of Crustacea, Florida.

DR. HENRY LOOMIS. Twenty-nine trays of crabs and *Brachiopoda*, purchased.

MRS. MARY LUDWIG SUYDAM. A sponge and corals.

#### VERTEBRATE FOSSILS.

MISS RUTH ANN SULLIVAN. Mammoth tooth (*Mammut primigenius*), Alaska.

#### FOSSIL INVERTEBRATE.

S. S. BERRY. *Tetractita rubescens* Dar. from Pt. Loma, California.

DAVID DALLAM. One slab of *Brachiopoda*.

MISS EMILY DROWN. *Nucula* from England.

E. J. POST. Two trays of *Brachiopoda* from Canada.

LLOYD B. SMITH. *Turritella gabbi* B. and P. from Tierra Nueva, Haiti.

#### ACCESSIONS: MINERALS.

MORRELL G. BIERNBAUM. Quartz, Rowlandville, Phila., Pa.; Spinel, Franklin, N. J.; Microcline, Frankford, Pa.; Muscovite, Broad and Olney Ave., Phila., Pa.; Copper, Schwenksville, Pa.

MRS. M. B. BRADBURY. Collection of minerals of Dr. N. R. Bradner.

MISS EMILY DROWN. Collection of 6000 minerals.

DR. J. B. S. EGEE. Picrophyll, Bavaria.

HORACE M. ENGLE. Molybdenite and Molybde, Ontario, Canada.

HAROLD EVANS. Pyrite, Moore Sta., N. J.

V. W. FIELD. Cyanite and Sphalerite, Idaho.

HUGH ALEXANDER FORD. Chabazite, Avondale, Delaware Co., Pa.

SAMUEL G. GORDON. Orthoclase, St. Peters, Pa.; Talc, Lafayette, Pa.; Byssolite, Cornwall, Pa.; Ferruginous Quartz, Lehigh Co., Pa.; Aragonite, Sterling Hill, N. J.; Pyrrhotite, MacAfee, N. J.; Calamine, Friedensville, Pa.; Pyrrhotite, Gottschall's Mine, Berks Co., Pa.; Calcite, Stilbite, Chabazite, Laumontite, Calcite, Trap Rock, Berks Co., Pa.; Hematite, Garnet, Knauertown, Chester Co., Pa.; Limonite, Upper Alsace, Berks Co., Pa.; Turgite, Udree's Mine, Berks Co., Pa.; Jefferisite, Brinton's Quarry, Chester Co., Pa.; Chabazite, Natrolite, Lenni, Delaware Co., Pa.; Titanite, Frankford, Pa.; Graphite, Zircon, Stilpnomelane, Chalcopryrite, Hopewell Mine, Warwick, Chester Co., Pa.; Magnetite, Chrysocola, Aragonite, Pyrite, Chalcopryrite, Jones Mine, Berks Co., Pa.; Limonite, Fleetwood, Berks Co., Pa.; Albite, Paterson, N. J.; Calcite, Amelia, Va.; Albite, Frankford, Pa.; Laumontite, Ward's Quarry, Delaware Co., Pa.; Quartz, Overbrook, Phila., Pa.; Siderite, Ward's Quarry, Delaware Co., Pa.; Orthoclase, O'Neill's Quarry, Frankford, Pa.; Calcite, Trap Rock, Berks Co., Pa.; Deweylite, Magnetite, Lafayette, Pa.; Covellite, Chalcopryrite, Calamine, Phoenixville, Pa.; Stilbite, Frankford, Phila., Pa.; Stilbite, Prehnite, Apophyllite, Trap Rock, Berks Co., Pa.; Wavellite (7 specimens), Beraunite, Hellertown, Pa.; Serpentine, Aragonite, Asbestos, Easton, Pa.; Calcite, Stilbite, Paterson, N. J.; Microcline, Aragonite, Crocidolite, Calcite, Orthoclase, Galena, Pyroxene, Willemite, Garnet, Franklin, N. J.; Kaolin in limonite geodes, Oreland, Pa.

H. HERWEGH. Limonite pseudo-Pyrite, Howard House, Delaware Co., Pa.; four stalactites, Crystal Cave, Kutztown, Berks Co., Pa.

CHARLES W. HOADLEY. Microcline, Valhalla, N. Y.

FRANK P. HOWE. Calamine, Embreeville, Tenn.

THOS. HARVEY. Fifteen minerals from Delaware Co., Pa.

HOWARD KULP. Calcite, Howellville, Chester Co., Pa.

BENTLY R. MORRISON. Chalcopryrite, Falls of French Creek, Chester Co., Pa.; Orthoclase, Falls of French Creek, Pa.

FREDERICK OLDACH. Prehnite, Calcite, Stilbite, Apophyllite, Trap Rock, Berks Co., Pa.

COL. W. A. ROEBLING (by exchange). Amber, Roebing, N. J.; Mixite, Tintic, Utah; Ettringite, Bellerberg, Germany, and Tombstone, Ariz.; Tamarugite, Tarapaca, Chile; Elpidite, Greenland; Svanbergite, Wermland, Sweden; Hibscheite, Aussig, Bohemia; Crestmoreite, Riverside, Cal.

DR. JOHN F. ROSE. Vermiculite, Roseite (4 specimens), West Nottingham, Chester Co., Pa.; Ligniform asbestos, Molybdenite, West Nottingham, Pa.

HARRY W. TRUDELL. Gypsum, Falls of French Creek, Chester Co., Pa.

H. L. WILLIG. Margarite, Pequea Mine, Lancaster Co., Pa.; Picrolite, Chromite, Deweylite, Wood's Chrome Mine, Lancaster Co., Pa.; Talc, White Rock, Lancaster Co., Pa.; Calcite, Wabank, Lancaster Co., Pa.; Limonite pseudopyrite, Chestnut Hill, Lancaster Co., Pa.; Galena, Rutile, Chloritoid, Pequea Mine, Lancaster Co., Pa.; Pyrrhotite, Cornog, Chester Co., Pa.; Tourmaline, Smoky Quartz, Gap Mines, Lancaster Co., Pa.; Tourmaline, Welsh Mt., Lancaster Co., Pa.; Cacoxenite, Beartown, Lancaster Co., Pa.; Kaolin, Narvon, Lancaster Co., Pa.; Calcite, Billmeyer Station, Lancaster Co., Pa.; Fluorite, Lancaster Co., Co., Pa.; Silicified Wood, Elizabethtown, Lancaster Co., Pa.; Tennantite, Bamfordville, Lancaster Co., Pa.; Asbestos, White Rock, Lancaster Co., Pa.

H. F. ZERGER. Pyrite, Columbia, Pa.; Andradite, Serpentine, Cornwall, Pa.

PURCHASED. For Wm. S. Vaux Collection 104 specimens.

#### HERBARIUM.

DR. W. L. ABBOTT. Small collection of plants from Doubling Gap, Cumberland Co., Pa.

H. G. ALLEBACH. *Helenium nudiflorum*, Green Lane, Pa.

WALTER M. BENNER. 14 specimens from Easton, Pa.

O. H. BROWN. 115 sheets of flowering plants, Cape May, N. J.

MACY CARHART. Small series of ferns from New Jersey.

CHARLES C. DEAN. A small collection of local plants.

EXCHANGE. N. Y. Botanic Garden, 123 sheets of Jamaican plants; Gray Herbarium, 556 sheets of Newfoundland and Labrador plants.

H. L. FISHER. *Plantago major*, Annandale, N. S.

C. D. FRETZ. 44 sheets of plants, Bucks Co., Pa.

F. J. KEELEY. *Camptosaurus rhigophius*, Chester Co., Pa.

BAYARD LONG. 30 sheets of *Eragrostis peregrina*, eastern Penn'a and N. J.

J. P. OTIS. 25 local plants and a small collection from California.

HAROLD W. PRETZ. 460 sheets of plants, Lehigh Co., Pa.

PURCHASED by the Academy. 1000 specimens of New England plants. By the Botanical Section 475 New England plants, 170 Florida plants and 350 Californian plants.

GEO. REDLES. Fertile fronds of *Mattencia struthiopteris* from Wissahickon Creek.

WITMER STONE. *Ilex opaca*, Cape May Pt., N. J.

U. S. DEPT. AGRICULTURE. (Through Dr. C. L. Shaw.) Plants from Chester Co., Pa., from herbarium of Dr. Ezra Michener.

#### ARCHÆOLOGY.

MISS DEWEY. Dance Spear and Belt from South America.

MISS EMILY DROWN. Roman Antiquities, etc.

MRS. L. BROWN HALL. Arrowpoint.

PHILIP INMAN. Arrowpoints from Florida.

CLARENCE B. MOORE. Additions to the Moore Collection.

C. HENRY RONEY. Aboriginal workshop material from near Bethlehem, Pa.

BY PURCHASE. Collection of ethnographica from the Pacific and from South America.

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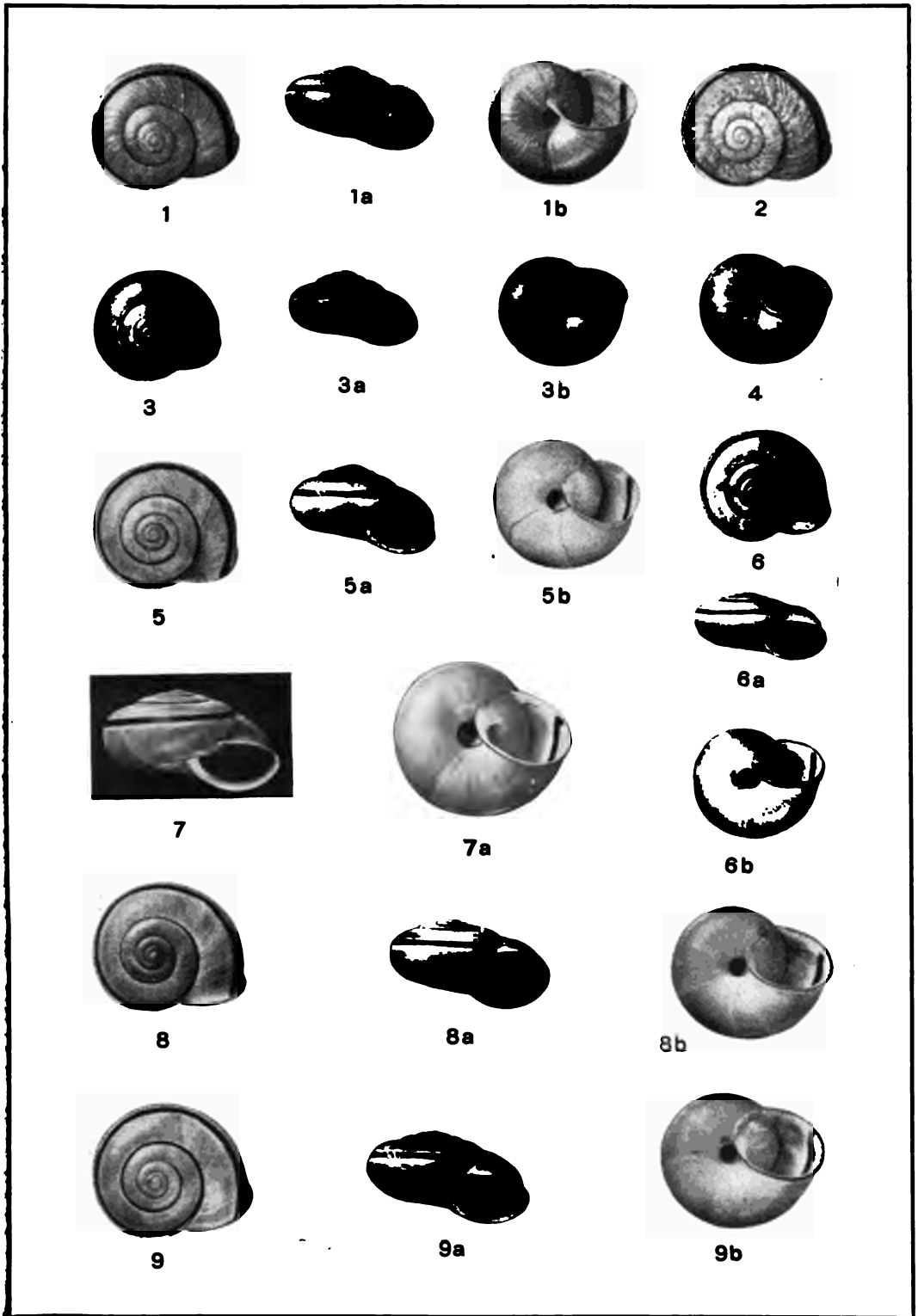
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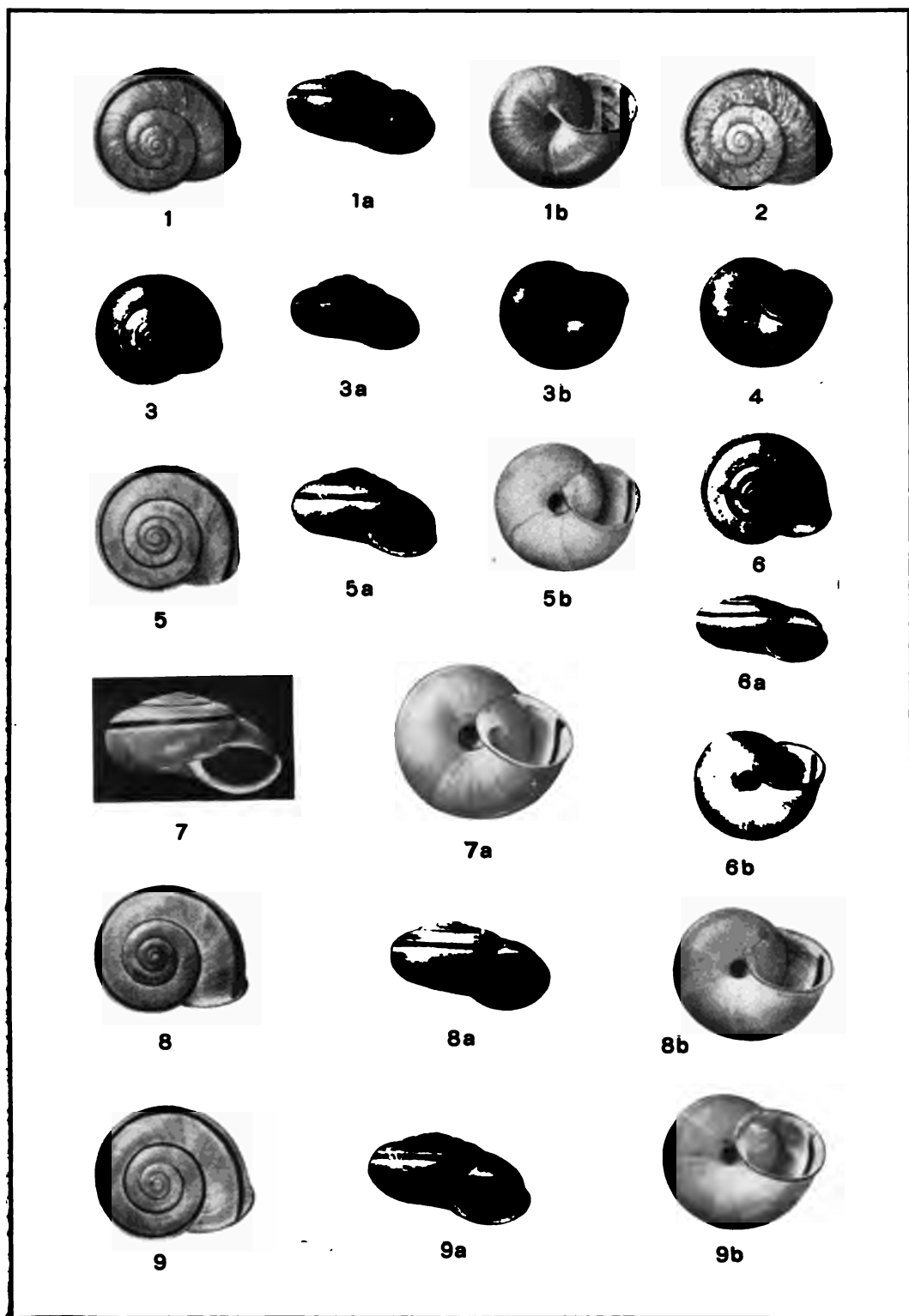
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PILSBRY AND FERRISS: SOUTHWESTERN MOLLUSCA.









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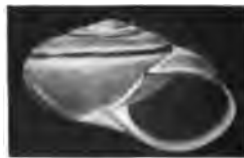
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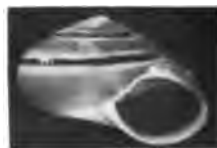
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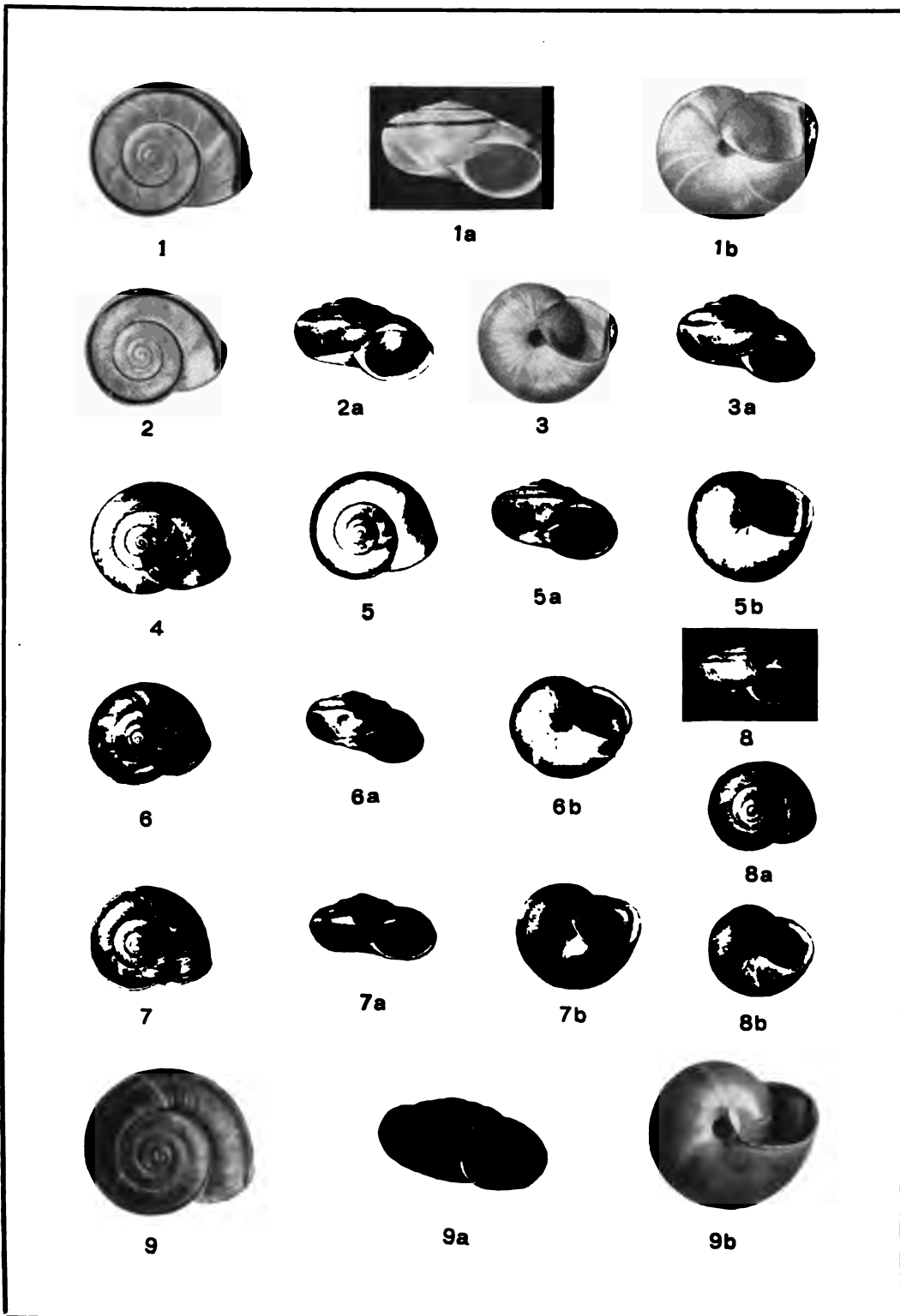


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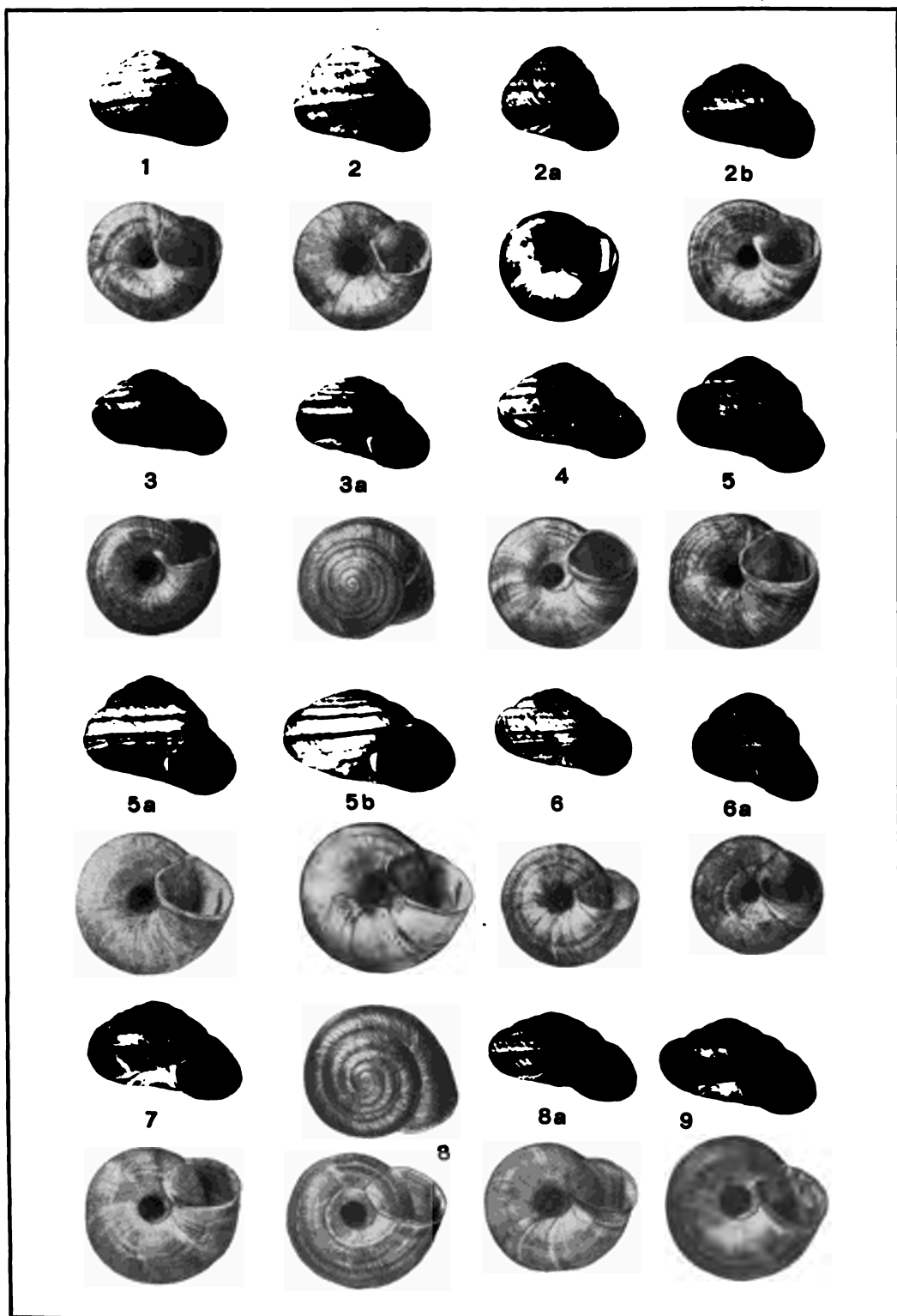
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PILSBRY AND FERRISS: SOUTHWESTERN MOLLUSCA.





PILSBRY AND FERRISS: SOUTHWESTERN MOLLUSCA.





PROCEEDINGS  
OF  
The Academy of Natural Sciences

OF  
PHILADELPHIA

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VOLUME LXXI

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1919

PHILADELPHIA:  
THE ACADEMY OF NATURAL SCIENCES  
LOGAN SQUARE  
1920

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA,  
March 13, 1920.

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EDWARD J. NOLAN, *Recording Secretary*,  
Per WILLIAM J. FOX, *Acting Editor*.

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**PROCEEDINGS**  
**OF THE**  
**ACADEMY OF NATURAL SCIENCES**  
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**PHILADELPHIA.**

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**1919**

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**January 21.**

**The President, JOHN CADWALADER, A.M., LL.D., in the Chair.**

**Twenty-seven persons present.**

**DR. WITMER STONE** made a communication on the plants of Cape May. (No abstract.)

**DR. HENRY A. PILSBRY** spoke of the results of his collecting, with **Mr. J. H. Ferris**, mollusks of southern Arizona. (No abstract.)

**The following was ordered to be printed:**

## NOTES ON SYNENTOGNATHOUS FISHES

BY HENRY W. FOWLER.

The fishes embraced in this order are commonly known as bill-fishes or green-gars, sauries, half-beaks and flying-fishes. With one exception, as noted below, all are contained in the collection of the Academy.

## BELONIDÆ.

At least two distinct sub-genera occur in the limits of *Belone* Cuvier. *Raphistoma* Rafinesque, as pointed out by Regan, may be accepted as a nomen nudum.

Sub-genus BELONE Cuvier.

Body compressed behind vent, without lateral keels. Gill-opening extends well forward. Gill-rakers moderate, lanceolate.

*Belone belone* (Linnaeus).

Eight from the Mediterranean.

PLATYBELONE new sub-genus.

Type *Belone platyura* Bennett.

Body broadly depressed behind, with strong lateral keels. Gill-opening rather restricted. Gill-rakers short points. (πλατύς, broad, with reference to the caudal peduncle; *Belone*.)

*Belone platyura* Bennett.

Two Hawaiian examples from J. K. Townsend. These examples are of interest historically, as among the first of the species obtained in the Hawaiian Islands, several years before Valenciennes described it as *Belone carinata*.

*B. trachura* Valenciennes also belongs in the present sub-genus.

STRONGYLURA Van Hasselt.

Bull. Sci. Nat. Férussac (2 sect.) II, 1824, p. 374. Type *Strongylura caudimaculata* Van Hasselt.

*Strongylura* Van Hasselt thus antedates *Tylosurus* Cocco,<sup>1</sup> and though without diagnosis is clearly based on the easily recognized

<sup>1</sup>Giorn. Sci. Lett. Sicilia, XLII, 1833, No. 124, 18.

figure and account by Russell. *S. caudimaculata* Van Hasselt was deliberately proposed to avoid tautonomy and replace *Belone strongylura* Van Hasselt of the preceding year, while both specific names gained usage through the works of Bleeker. The species with large scales and blunt caudal fin may then remain in the sub-genus *Strongylura* Van Hasselt, while the larger and more finely-scaled species with forked caudals may contain *Tylosurus* Cocco.

***Strongylura strongylura*** (Van Hasselt).

Philippines.

***Strongylura notata*** (Poey).

A large series from Florida (Stuart, Boca Grande, Marquesas Keys, Big Pine Key, Hailer's Rock, Boca Chica Key, Bayport, West Palm Beach and Key West).

***Strongylura scapulare*** (Jordan and Culver).

Panama.

***Strongylura timucu*** (Walbaum).

Colon, and Santo Domingo, W. I.

***Strongylura exilis*** (Girard).

San Diego, Cal.

***Strongylura peruana*** new species. Fig. 1.

Head, from tip of frontal process,  $5\frac{1}{4}$ ; depth  $1\frac{1}{2}$  in postocular; D. II, 12; A. II, 14; P. I, 10; V. I, 5; scales about 350 from opposite upper hind edge of gill-opening to caudal base medially; about 235 scales between occiput and dorsal origin; eye  $2\frac{3}{4}$  in postocular; interorbital  $2\frac{2}{3}$ ; first branched dorsal ray about  $1\frac{1}{2}$ ; first branched anal ray about  $1\frac{1}{4}$ ; pectoral 1; ventral  $1\frac{3}{4}$ .

Body elongate, moderately slender, cylindrical. Caudal peduncle cylindrical, or about broad as deep, least depth  $1\frac{1}{2}$  in eye, and with slight keel each side behind for lateral line.

Head level above, flattened sides narrowly constricted below, width  $1\frac{2}{3}$  in postocular. Jaws not completely closing basally, snout width at eyes long as frontal process. Eye little ellipsoid, close to upper profile though not impinging. Maxillary well exposed, reaches beyond front of eye or half way in front part of iris to pupil. Band of outer teeth in jaws very fine and narrow, and larger inner well spaced. No teeth on mouth roof. Tongue



elongate, pointed, free. Triangular nasal cavity about long as pupil. Interorbital and top of head with rather shallow concave median depression, not extending back to occiput. Few ridges or striæ on bones of head above. Opercle width about wide as cheek.

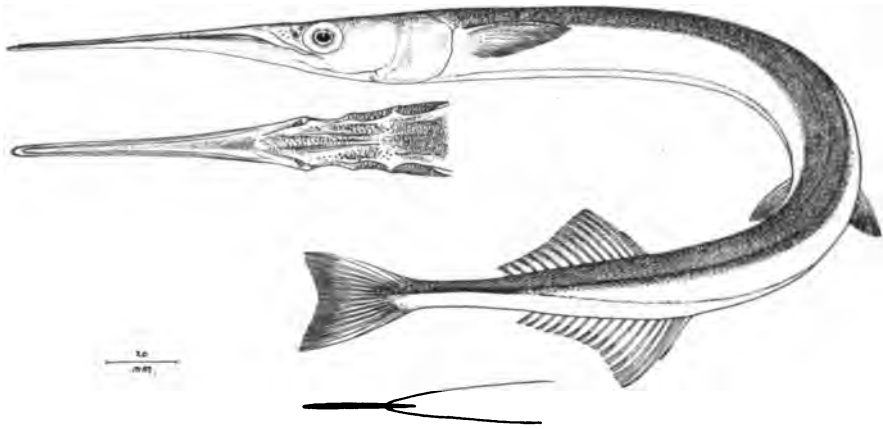


Fig. 1.—*Strongylura peruana*.

Gill-opening extends forward to front pupil edge. No rakers. Gill-filaments  $1\frac{1}{2}$  in eye. Isthmus long narrow frenum.

Scales small, uniform, each with about 18 to 20, coarse complete circuli. Maxillary, sides of mandible basally, opercles, and most of head covered with fine scales. Cheek with about 30 rows of scales behind eye to preopercle ridge. Front of dorsal and anal basally with small scales. Lateral line with short branch to pectoral base, and behind extends up midway along caudal peduncle side on keel to caudal base.

Dorsal inserted about last fourth between hind eye edge and caudal base, front rays elevated as lobe. Anal similar, inserted little before dorsal. Caudal broad, hind edge (damaged) emarginate or with lower lobe slightly longer. Pectoral inserted little high, pointed, and uppermost or simple ray enlarged. Ventral rather obtuse, inserted about midway between hind preopercle edge and caudal base. Vent about half an eye-diameter before anal.

Color in alcohol dull, brownish generally, sides and below paler or with brassy to silvery reflections. Narrow brassy-lead streak

along side, most distinct at front of dorsal and anal. Iris pale. Fins all dull brownish.

Length (beak broken) 310 mm.

Type, No. 21,924, A. N. S. P. Callao Bay, Peru. Prof. James Orton. Collection of 1876-1877. Prof. E. D. Cope.

Only the type known. Allied with *Strongylura exile*, but differs in the shorter preorbital, less notched maxillary, slightly fewer branched dorsal and anal rays and larger scales. (Named for Peru.)

***Strongylura marina*** (Walbaum).

A large series from Massachusetts (Wood's Hole); New Jersey (Barnegat, Great Bay, Atlantic City, Ocean City, Sea Isle City, Corson's Inlet, Newbold's Island, Florence and Duck Island); Pennsylvania (Delaware River, Philadelphia, Torresdale, Susquehanna River, Peach Bottom); Maryland (Chesapeake Bay, Elk Neck, Pool Creek, Charlestown, Ocean City); and Florida (Bayport and Boca Grande).

***Strongylura leiuroides*** (Bleeker).

Philippines.

***Strongylura anostomella*** (Valenciennes).

Hakodate, Japan.

***Strongylura leiura*** (Bleeker).

Padang, Sumatra.

***Strongylura raphidoma*** (Ranzani).

Kingston, Jamaica, and Culebra, Porto Rico.

***Strongylura acus*** (Lacépède).

A series of all ages: Massachusetts (Nantucket); New Jersey (Sea Isle City and Ocean City); Pennsylvania (Susquehanna River); Mediterranean.

***Strongylura coromandelica*** (Van Hasselt).

Padang, Sumatra.

***Strongylura crocodila*** (Le Sueur).

Padang, Sumatra. Although I have only the present example from the East Indies, it differs slightly from one I identified as *Tylosurus choram* (Rüppell) obtained in the Camaroons. The

Padang fish differs in the maxillary reaching the pupil, gill-opening extending forward about to front pupil edge, longer hind dorsal rays and much finer scales, though the last structurally identical.

**Xenentodon cancila** (B. Hamilton).

Ganges River, India.

**Potamorhaphis guianensis** (Schomburgk).

Peruvian Amazon and Rupununi River. *Potamorhaphis eigenmanni* Ribeiro<sup>2</sup>, from Paraguay, has D. 28. A. 25 and scales 136 to 150. My examples reveal an extent of variation not quite so low as these formulas, other characters well within the limits, and still others exceeding even some Dr. Ribeiro gives for *P. guianensis*.

**Ablennes hians** (Valenciennes).

St. Christopher's Island, British West Indies.

#### SCOMBERESOCIDÆ.

**Scomberesox saurus** (Walbaum).

Newport, R. I.; Cape Cod, Mass. Three from the Atlantic in the Bonaparte Collection.

#### HEMIRAMPHIDÆ.

**Chriodorus atherinoides** Goode and Bean.

Marquesas Keys and Hailer's Rock, Florida.

**Hyporhamphus pacificus** (Steindachner).

Hawaiian Islands.

**Hyporhamphus neglectus** (Bleeker).

Padang, Sumatra.

**Hyporhamphus unifasciatus** (Ranzani).

Colon, Canal Zone; St. Martin's, W. I.; Trinidad; Boqueron, Porto Rico; West coast of Mexico; Los Animas Bay, Lower California. Provisionally this species may be retained as the short-billed form, though I have but one example from the Boqueron lot and another from the west coast of Mexico as exceptions. None of the young appear to have longer beaks than the adults.

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<sup>2</sup> Arch. Mus. Nac. Rio Janeiro, XVII, 1915, p. 13.

**Hyporhamphus roberti** (Valenciennes).

Newport, Rhode Island; Corson's Inlet, New Jersey; Volusia, St. Augustine, Key West and Point Puellas, West Florida. In most examples, or excepting the largest, which from Rhode Island, and another from Key West, the ventral origin is about midway between preopercle edge and caudal base. In the exceptions it is about midway between hind eye edge and caudal base. All, however, have the beak over twice the head length as measured after front eye edge.

**Hyporhamphus kurumeus** Jordan and Starks.

Chikugo River at Kurume, Japan.

**EULEPIDORHAMPHUS** new sub-genus.

Type *Hemiramphus sajori* Schlegel.

Distinguished from the sub-genus *Hyporhamphus* Gill by its very small scales, 90 to 100 in lateral series. (Εὖ, well; λεπίς, scale; ῥάμφος, beak.)

**Hyporhamphus sajori** (Schlegel).

Hakodate and Kushiro, Japan.

**Hemiramphus intermedius** Cantor.

Victoria, Australia. Though Günther says<sup>3</sup> dorsal and anal scaleless, and Macleay<sup>4</sup> apparently copies, McCoy<sup>5</sup> shows the dorsal and anal scaleless. The last, however, indicated the dorsal entirely with broken or somewhat dotted horizontal dark lines, which are not clearly intended as scales. In my examples the membranes of the soft dorsal and anal are covered with fine narrow scales for at least  $\frac{2}{3}$  basally.

**Hemiramphus far** (Forskål).

Philippines; Padang, Sumatra; Zanzibar.

**Hemiramphus brasiliensis** (Linnaeus).

Sea Isle City, New Jersey; Chesapeake Bay; Aguadilla, Porto Rico; St. Kitts and St. Croix, West Indies; Port Antonio, Jamaica; Christian Island, west coast of Mexico; Honolulu, Hawaiian Islands.

<sup>3</sup> Cat. F. Brit. Mus., VI, 1866, p. 260.

<sup>4</sup> Proc. Linn. Soc. N. S. Wales, V, 1881, p. 181.

<sup>5</sup> Nat. Hist. Victoria, II, 1890, p. 133, Pl. 135, fig. 1.

*Hemiramphus limbatus* Valenciennes.

Philippines.

*Hemiramphus quoyi* Valenciennes.

Philippines.

*Hemiramphus affinis* Günther.

Apia, Samoa.

*Zenarchopterus hendersoni* new species. Fig. 2.

Head (from upper jaw tip) 4; depth  $9\frac{1}{4}$ ; D. I, 12; A. II, 9; P. I, 7; V. I, 5; scales 45 in lateral series from shoulder to caudal base medially; 34 scales before dorsal to head; 5 scales above lateral line at dorsal origin, and 1 below at anal origin; snout  $2\frac{1}{2}$  in head from upper jaw tip; eye 5; maxillary  $2\frac{3}{4}$ ; interorbital  $3\frac{3}{4}$ ; first branched dorsal ray about 4; first branched anal ray about  $3\frac{3}{4}$ ; least depth of caudal peduncle  $3\frac{3}{4}$ ; caudal  $1\frac{3}{4}$ ; pectoral  $2\frac{1}{4}$ ; ventral about 4.

Body moderately elongate and compressed, more especially behind dorsal and anal origins, and back at present much broader than belly. Caudal peduncle short, its length little less than eye.

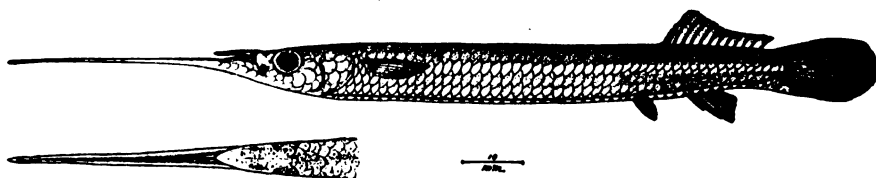


Fig. 2.—*Zenarchopterus hendersoni*.

Head well compressed, flattened sides narrowly convergent below, width  $3\frac{1}{2}$  in its length from upper jaw tip. Upper jaw depressed, elongate, triangular, width at front of eyes  $1\frac{1}{2}$  its length. Eye moderate, about half of snout, touches upper profile, and midway in head length. Mouth with rather long, horizontal gape, at least  $\frac{2}{3}$  to eye. Maxillary concealed, reaches opposite nasal cavity. Teeth minute, conic, in narrow bands in jaws, though bands of lower only extend forward about  $\frac{2}{3}$  as far as upper. Front maxillary edge with narrow band of fine teeth. No teeth on roof of mouth. Lower jaw produced as long, flattened beak,

edges entire, and head behind front eye edge about 3 in its length. Nasal cavity about  $\frac{2}{3}$  of pupil, superior. Interorbital flattened.

Gill-opening extends forward about opposite front pupil edge. Gill-rakers 5+11, lanceolate, longest about  $\frac{2}{3}$  of filaments and latter  $2\frac{1}{2}$  in eye. Isthmus narrow slender frenum.

Scales moderately large, cycloid, rather narrowly imbricated, basal striæ 4 to 6, basal circuli 35 to 40 and terminal faces entire. Head scaly, a single row of large scales on cheek, and scales on opercles large. Several rows of small scales on caudal base, and dorsal and anal apparently without scales. Lateral line complete, low along side, and extends up behind just below median scale at caudal base, all tubes simple.

Dorsal inserted at last fourth between hind edge of gill-opening and caudal base, last ray reaching back little beyond latter. Anal inserted trifle behind dorsal origin, much shorter than dorsal. Caudal rounded behind. Pectoral placed high, small. Ventral inserted scarcely before last third in space between hind edge of gill-opening and caudal base, fins not quite half way to anal: Vent close before anal.

Color in alcohol pale, dull brownish generally, more or less uniform. Sides of head and below with traces of silvery reflections. A narrow silvery-gray lateral band, about wide as pupil, most conspicuous between dorsal and anal.

Length 142 mm.

Type, No. 7,584, A. N. S. P. Japan. Dr. A. A. Henderson.

This species, known only from the type described above, is closely related to *Zenarchopterus amblyurus* (Bleeker). According to Bleeker's figure<sup>6</sup>, it differs in the more posterior insertion of the ventral, shorter row of lower teeth, apparently more rounded caudal and scaleless dorsal fin. This specimen has long been in the Academy, probably sixty years or more, and still has the original labels intact.

(Named for Dr. A. A. Henderson.)

*Zenarchopterus philippinus* (Peters).

Philippines.

*Zenarchopterus dispar* (Valenciennes).

Philippines.

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<sup>6</sup> Atlas Ichth., VI, 1866-72, p. 61, Pl. 4, fig. 1.

**Dermatogenys viviparus** (Peters).

Philippines.

**Euleptorhamphus velox** (Poey).

Atlantic City, N. J.

**Hemioxocostus caudimaculatus** Fowler.

Proc. Acad. Nat. Sci. Phila., 1901, p. 293, fig. N. Lat. 23° W. Long. 106°  
(Mazatlan, Mexico).

No. 7,508, A. N. S. P., type.

#### EXOCOETIDÆ.

**Fodiator acutus** (Valenciennes).

Panama.

**Evolantia microptera** (Valenciennes).

An example from south of the Revillagigedo Islands (Dr. Wm. H. Jones). The label says "from the stomach of a gannet captured June, 1875, 150 miles south of the Revillagigedo Islands, and stomach had 11 fish of same kind."

**Parexocostus brachypterus** (Richardson).

Hawaiian Islands.

**Parexocostus mesogaster** (Bloch).

Newport, Rhode Island; St. Martin's, West Indies.

**Exocetus volitans** Linnaeus.

*Exocetus chilensis* Abbott, Proc. Acad. Nat. Sci. Phila., 1860, p. 472. Chili.

Nos. 7498 and 7499, A. N. S. P., co-types of *E. chilensis* Abbott. Others from the Atlantic Ocean, "in the tropics," Indian Ocean, Hawaii and Victoria, Australia.

**Cypselurus exsiliens** (P. L. S. Müller).

N. Lat. 31° 30' W. Long. 36° 36'.

**Cypselurus rondeleti** (Valenciennes).

Two adults, Gulf of Mexico and the Bonaparte Collection, respectively.

**Cypselurus polyethmus** new species. Fig. 3.

Head  $4\frac{3}{4}$ ; depth 6; D. 11, 9; A. 11, 10; P. 11, 15; V. 1, 5; scales (pockets) about 40 counted from shoulder to caudal base medially; 27 scales before dorsal to occiput; about 8 scales (pockets) above

l. l. to dorsal origin; snout  $3\frac{3}{4}$  in head, measured from upper jaw tip; eye  $3\frac{1}{4}$ ; maxillary  $3\frac{3}{4}$ ; interorbital  $2\frac{1}{2}$ ; least depth of caudal peduncle  $3\frac{3}{4}$ .

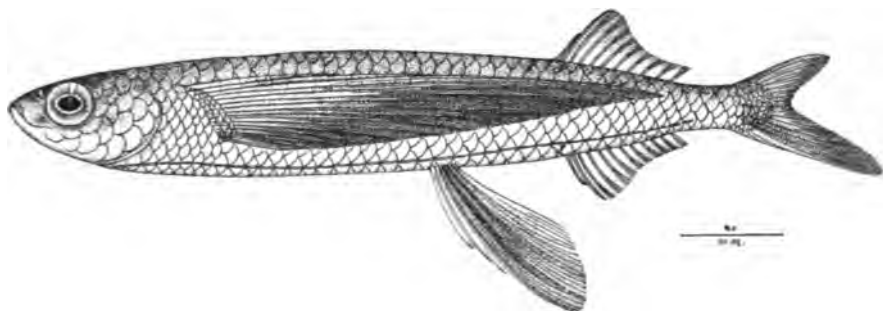


Fig. 3.—*Cypselurus polyethmus*.

Body elongately fusiform in contour, deepest medially, broad and depressed above forward, and becoming well compressed behind. Caudal peduncle compressed, least depth  $1\frac{2}{3}$  its length.

Head broadly depressed above, flattened sides narrowly constricted below, width  $1\frac{2}{3}$  its length, and lower profile much more inclined. Snout broadly depressed, length  $\frac{2}{3}$  its width. Eye high, large, impinging slightly on upper profile, hind pupil edge slightly in advance of head center. Mouth small, with short gape, and mandible slightly protruding beyond snout tip. Teeth minute, feeble, only a few scattered along front edges of trenchant jaws, which otherwise smooth. Mouth roof toothless. Maxillary largely concealed, only narrow lower edges exposed, reaches eye. Tongue smooth, depressed, moderately long, front end rounded and free. Nasal cavity triangular, about half of pupil. Preorbital  $1\frac{2}{3}$  in eye. Interorbital broad, level.

Gill-opening extends forward to nasal cavity. Gill-rakers 9+21, lanceolate, very slightly less than filaments which  $1\frac{1}{2}$  in eye. Isthmus slender frenum in front.

Scales large, very caducous, cycloid, rather narrowly exposed, largest anteriorly on back and head above, basal radii 4 to 6, circuli complete, about 36 to 40. Dorsal and anal apparently scaleless, though caudal base scaly. Head covered with scales, though apparently edge of snout rather broadly naked. Breast covered with moderately small scales.

Dorsal origin about last third in space between hind gill-opening edge and caudal base, front rays a little elevated. Anal inserted



about opposite dorsal origin, similar to dorsal. Caudal well forked, lobes pointed and lower apparently much longer (damaged) and about long as head. Pectoral long, reaches back to last dorsal ray base, its first and second uppermost rays simple. Ventral inserted slightly nearer head than caudal base, reaches back not quite so far as pectoral or about  $\frac{2}{3}$  to caudal base, with median branched ray longest. Vent close before anal.

Color in alcohol pale brown on back, sides and below silvery-whitish. Dorsal and caudal pale, medially tinged with brown. Pectoral deep brownish over greater median portion, blackish inside, though extreme inner edge and whole outer edge whitish. Anal whitish, also ventral, though latter with quite large median lengthwise brownish area. Iris whitish and muzzle pale.

Length 175 mm.

Type, No. 7,493, A. N. S. P. Atlantic Ocean. C. L. Bonaparte (No. 346).

Only the above described example known, which differs from *Cypselurus rondeleti* in the shorter pectoral and more numerous gill-rakers. My examples of *C. rondeleti* show the pectoral reaching the caudal base and the gill-rakers 7+15, though the larger 248 mm. long.

(πολύς, many; ῥήμους, strainer, or gill-raker, as here understood.)

*Cypselurus vinciguerrae* (Jordan and Meek).

Adult from Gulf of Mexico.

*Cypselurus hyperistius* new species. Fig. 4.

Head  $4\frac{1}{2}$ ; depth 6; D. 11, 9; A. 11, 9; P. 1, 17; V. 1, 5; scales 50 counted from shoulder to caudal base medially and 4 more on latter; 31 predorsal scales to head; 7 scales above l. l. to dorsal origin; snout 4 in head, measured from upper jaw tip; eye 3; maxillary  $3\frac{3}{4}$ ; interorbital  $2\frac{1}{4}$ ; least depth of caudal peduncle  $3\frac{1}{2}$ .

Body elongate, robust forward where also constricted below and upper surface broadened, though posterior regions well compressed. Caudal peduncle well compressed, least depth about  $1\frac{1}{2}$  its length.

Head broadly depressed above, flattened sides narrowly constricted below, width  $1\frac{1}{2}$  its length, and front profiles about evenly inclined. Snout moderately broad, conic, length about  $\frac{2}{3}$  its width. Eye very large, high, greatly impinging on upper profile, and hind pupil edge slightly advanced from center in head length.

Mouth small, with short inclined gape, and mandible slightly protruded beyond snout tip. Teeth small, simple, conic, and as very narrow band or row along front edges of trenchant jaws. Mouth roof toothless. Maxillary well exposed, or at least lower half its whole length, extends slightly beyond front of eye or not quite half way in iris to pupil. Tongue smooth, depressed, moderately long, front end rounded and free. Nasal cavity close before eye, about half of pupil. Preorbital rather slender,  $1\frac{1}{2}$  in eye. Interorbital broad, slightly concave.

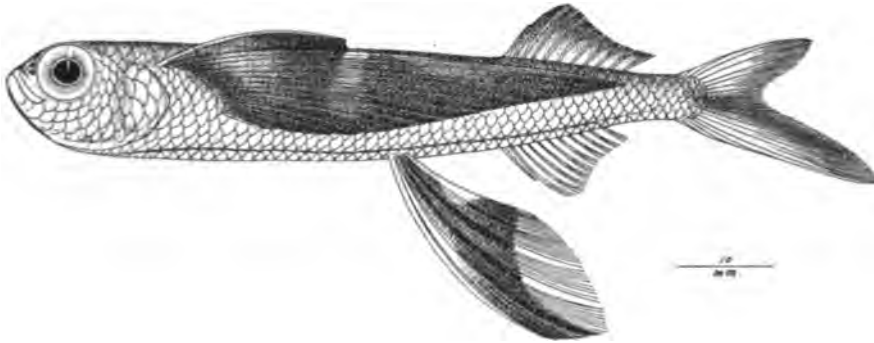


Fig. 4.—*Cypselurus hyperistius*.

Gill-opening extends forward to front eye edge. Gill-rakers 7+17, lanceolate, about long as filaments, which slightly less than 2 in eye. Isthmus long slender frenum in front.

Scales large, mostly adherent, cycloid, moderately exposed, largest anteriorly on back and head above, basal radii 3 to 5, circuli complete, about 26 to 30. Dorsal and anal apparently scaleless, though caudal base scaly. Head covered with scales, 2 or 3 rows on cheek and edge of snout rather broadly naked. Breast scales of moderate size. Lateral line apparently not beyond anal as squamation damaged.

Dorsal origin at last third between hind pupil edge and caudal base, front rays a little elevated. Anal origin slightly before that of dorsal, fin similar. Caudal well forked, lobes pointed and lower much longer or about equals head and eye length. Pectoral long, reaches back not quite far as last depressed dorsal and anal rays, thus not quite to caudal base, and first or uppermost simple ray connected with next or first branched ray by broad membrane. Ventral inserted midway between hind eye

edge and caudal base, simple ray about  $\frac{3}{4}$  length of first branched ray which longest, fin thus reaching slightly nearer caudal base than last depressed dorsal or anal rays. Vent close before anal.

Color in alcohol with back and upper surfaces dull brownish, sides and below silvery-whitish, also iris. Muzzle pale, and broad, dull blackish streak on chin to front of branchiostegals. Dorsal and caudal pale brownish, ends of long front rays of former blackish. Anal whitish. Pectoral with membranes largely blackish, lower face of fin with silvery tinge, inner edge whitish and at point near basal  $\frac{1}{2}$  pale cross-bar half way from upper edge. Ventral largely blackish medially, edges and end broadly whitish.

Length about 92 mm. (Caudal tip damaged.)

Type, No. 7,485, A. N. S. P. St. Martins, West Indies. Dr. R. E. Van Rijgersma.

Only the type known. This species is allied with *Cypselurus vinciguerræ*, but differs in the uppermost or elongate simple ray of the pectoral being provided with a broad membrane.

(Υπερ, over; ιστίον, sail; with reference to the structure of the pectoral fin.)

***Cypselurus speculiger*** (Valenciennes).

Atlantic Ocean.

***Cypselurus rufipinnis*** (Valenciennes).

*Exocetus scylla* Cope, Trans. Amer. Philos. Soc. Phila., (n. s.) XIV, 1871, p. 481. Tobasco, Mexico.

No. 7,500, A. N. S. P., type of *E. scylla* Cope.

***Cypselurus heterurus*** (Rafinesque).

St. Martins, West Indies.

***Cypselurus lutkeni*** (Jordan and Evermann).

*Exocetus lutkeni* Jordan and Evermann, Bull. U. S. Nat. Mus., No. 47, I, 1896, p. 736. "Cape San Antonio, Cuba." (Evidently erroneous.)

No. 7,502, A. N. S. P., type of *E. lutkeni* Jordan and Evermann.

***Cypselurus furcatus*** (Mitchill).

Atlantic Ocean and Newport, R. I.

***Cypselurus bicolor*** (Valenciennes).

S. Lat. 18° 20' 5" W. Long. 34° 5'.

***Cypselurus nigricans*** (Bennett).

Sea Isle City, N. J.

**Cypselurus lineatus** (Valenciennes).

One mile north of Funchal, Madeira (September 17, 1912).  
Joseph Redl.

**Cypselurus bahiensis** (Ranzani).

An example about a foot long, was kindly loaned to me by  
Dr. P. P. Calvert, now in his possession. It "flew" on board a  
vessel off the coast of Brazil.

**Cypselurus californicus** (Cooper).

San Pedro, California. Also others from Santa Catalina, re-  
ceived from Messrs. Morgan Hebard and J. A. G. Rehn.

**Cypselurus agoo** (Schlegel).

Tsuruga, Yokahama and Miyako, Japan.

**Cypselurus quindecimradiatus** Fowler.

*Cypselurus quindecimradiatus* Fowler, Proc. Acad. Nat. Sci. Phila., 1899,  
p. 482, Pl. 17. Thornton Island, South Pacific.

No. 23,275, A. N. S. P., type of *C. quindecimradiatus* Fowler.

**Cypselurus simus** (Valenciennes).

Honolulu, Hawaiian Islands.

**Cypselurus gibbifrons** (Valenciennes).

Newport, Rhode Island.

February 18.

The President, JOHN CADWALADER, A.M., LL.D., in the Chair.

Forty-nine persons present.

DR. EDGAR FAHS SMITH spoke of the mineralogists and chemists associated with the early history of the Academy. (No abstract.)

George L. Harrison, Jr., was elected a member of the Council to serve one year, and Roswell C. Williams, Jr., to serve two years.

W. Judson Coxey was elected a member.

The following was ordered to be printed:

**MOLLUSCA FROM THE UPPER MIOCENE OF SOUTH CAROLINA WITH  
DESCRIPTIONS OF NEW SPECIES**

BY JULIA A. GARDNER AND T. H. ALDRICH

The exact locality from which the mollusca listed in this paper were collected is known as the Muldrow Place, Sumter County, South Carolina, and is located five miles southeast of Mayesville. The material is a blue clay marl twelve feet thick, exposed on some small streams. Normally it is overlaid by about twelve feet of sand and loam. Earle Sloan listed it on p. 308 of his "Catalogue of the Mineral Localities of South Carolina," and named it "Upper Pee Dee Phase" of the Miocene. It seems to be very nearly of the same age as the Duplin beds farther north, and contains a great number of the same species. The fauna is more tropical in character than the Miocene of Maryland and Virginia.

*List of species*

- |   |  |
|---|--|
| <i>Malampus lineatus</i> Say.                         | <i>Cancellaria (Trigonostoma) tenera</i> Philippi.                   |
| <i>Aceon</i> cf. <i>shilohensis</i> Whitfield.        | <i>Oliva litterata</i> Lamarck.                                      |
| <i>Aceocina canaliculata</i> (Say).                   | <i>Olivella mutica</i> (Say).  |
| <i>Aceocina myrmecoon</i> Dall.                       | <i>Marginella borealis</i> Verrill.                                  |
| <i>Volvula oxytata</i> Bush.                          | <i>Marginella contracta</i> Conrad.                                  |
| <i>Terebra carolinensis</i> (Conrad).                 | <i>Marginella bella</i> (Conrad).                                    |
| <i>Terebra neglecta</i> Emmons.                       | <i>Marginella denticulata</i> Conrad.                                |
| <i>Terebra dislocata</i> Say.                         | <i>Marginella aureocincta</i> Stearns.                               |
| <i>Terebra indenta</i> Conrad.                        | <i>Marginella</i> aff. <i>avena</i> subsp. <i>avenacea</i> Deshayes. |
| <i>Terebra concava</i> Say.                           | <i>Marginella gravida</i> Dall.                                      |
| <i>Conus marylandicus</i> Green.                      | <i>Marginella antiqua</i> Redfield.                                  |
| <i>Conus adversarius</i> Conrad.                      | <i>Marginella oliviformis</i> Tuomey & Holmes.                       |
| <i>Drillia tricalenaria</i> Conrad.                   | <i>Marginella minuta</i> Pfeiffer.                                   |
| <i>Drillia myrmecoon</i> Dall.                        | <i>Marginella (Volutella) dacria</i> Dall.                           |
| <i>Drillia elegans</i> Emmons.                        | <i>Aurinia mutabilis</i> (Conrad).                                   |
| <i>Drillia tuberculata</i> Emmons.                    | <i>Mitra carolinensis</i> Conrad.                                    |
| <i>Drillia aphanitoma</i> subsp. <i>ozia</i> Dall.    | <i>Mitra wandoensis</i> (Holmes).                                    |
| <i>Drillia precursor</i> n. sp.                       | <i>Mitra dalli</i> n. sp.  |
| <i>Drillia sumterensis</i> n. sp.                     | <i>Mitromorpha mitrodita</i> n. sp.                                  |
| <i>Drillia limatula</i> Lea.                          | <i>Fasciolaria rhomboidea</i> Rogers.                                |
| <i>Drillia perpolita</i> Dall.                        | <i>Busycon pyrum</i> subsp. <i>excavatum</i> Conrad.                 |
| <i>Drillia polygonalis</i> Dall.                      | <i>Busycon concinnum</i> Conrad.                                     |
| <i>Drillia pagodula</i> Dall.                         | <i>Busycon maximum</i> Conrad.                                       |
| <i>Drillia simpsoni</i> Dall.                         | <i>Busycon perversum</i> Linné.                                      |
| <i>Mangilia eritima</i> Bush.                         | <i>Ecphora quadricostata</i> (Say).                                  |
| <i>Mangilia</i> aff. <i>rubella</i> Kurtz & Stimpson. | <i>Fusinus ? exilis</i> (Conrad).                                    |
| <i>Glyphostoma johnsoni</i> Dall.                     |  |
| <i>Cancellaria tabulata</i> n. sp.                    |  |
| <i>Cancellaria venusta</i> Tuomey & Holmes.           |  |

- Fusinus caloosensis* subsp. *carolinensis* Dall.  
*Pisania* (*Calatoconus*) *nux* Dall.  
*Nassaria* (*Nassarina*) *glypta* Bush.  
*Ptychosalpinx laqueatum* Conrad.  
*Phos sloani* n. sp.  
*Ilyanassa granifera* Conrad.  
*Alectrion scalaspira* (Conrad).  
*Alectrion johnsoni* (Dall).  
*Alectrion vibex* (Say).  
*Alectrion ? consensa* Ravenel.  
*Alectrion neogenensis* n. sp.  
*Anachis ? camaz* Dall.  
*Anachis sumterensis* n. sp.  
*Anachis styliola* n. subsp. *obsoleta*.  
*Anachis anomala* n. sp.  
*Astyrus communis* n. subsp. *carolinensis*.  
*Astyrus lunata* (Say).  
*Murex* (*Chicoreus*) aff. *burnsii* Whitfield.  
*Murex* (*Pterorytis*) *conradi* Dall.  
*Ocenebra cellulosa* (Conrad).  
*Urosalpinx trossulus* (Conrad).  
*Urosalpinx phriknos* n. sp.  
*Muricidea* aff. *floridana* (Conrad).  
*Peristernia filicata* Conrad.  
*Coralliophila lepidota* Dall.  
*Epitonium muldrowi* n. sp.  
*Epitonium* aff. *lineatum* Say.  
*Niso ? willcoxia* Dall.  
*Melanella bartshi* n. sp.  
*Melanella magnoliana* n. sp.  
*Strombiformis dalli* n. sp.  
*Cassia hodgei* Conrad.  
*Cypraea carolinensis* Conrad.  
*Erato ? maugeriae* Gray.  
*Triforis ? nodesta* C. B. Adams.  
*Seila clavulus* (H. C. Lea).  
*Cerithiopsis* aff. *subulata* Montagu.  
*Cerithiopsis* aff. *greenei* (C. B. Adams).  
*Caecum cooperi* Sanderson Smith.  
*Caecum flemingi* n. sp.  
*Caecum ibex* Dall.  
*Vermetus* (*Petalochonchus*) *sculpturatus* H. C. Lea.  
*Turritella etiwanensis* Tuomey & Holmes.  
*Turritella duplinensis* n. sp.  
*Turritella carolinensis* Conrad.  
*Turritella burdeni* (Tuomey & Holmes).  
*Fossarus lura* Conrad.  
*Architectonica granulata* Lamarck.  
*Rissoina johnsoni* Dall.  
*Crucibulum auriculum* subsp. *imbricatum* (Sowerby).  
*Crucibulum auriculum* subsp. *spinosum* (Sowerby).  
*Crucibulum constrictum* Conrad.  
*Crucibulum multilineatum* Conrad.  
*Calyptrea centralis* Conrad.
- Crepidula fornicata* (Linné).  
*Crepidula aculeata* subsp. *costata* Morton.  
*Crepidula plana* Say.  
*Natica canrena* Linné.  
*Natica pusilla* Say.  
*Polynices* (*Neverita*) *duplicatus* Say.  
*Polynices* (*Lunatia*) *internus* (Say).  
*Polynices* (*Lunatia*) aff. *perspectivus* Rogers.  
*Sinum ? perspectivum* (Say).  
*Eunaticina carolinensis* Dall.  
*Collonia* aff. *elegantula* Dall.  
*Chlorostoma* (*Omphalium*) *exoleta* Conrad.  
*Calliostoma* aff. *willcoxia* Dall.  
*Calliostoma* aff. *aluminum* Dall.  
*Calliostoma* aff. *bellum* (Conrad).  
*Calliostoma* (*Eutrochus*) *arnillatum* Tuomey & Holmes.  
*Liotia* (*Arene*) *gemma* Tuomey & Holmes.  
*Liotia* (*Arene*) *major* n. sp.  
*Teinostoma carinatum* (H. C. Lea).  
*Cochliolepis* aff. *striata* Dall.  
*Episcynia multicarinata* Dall.  
*Fissuridea catelliformis* Rogers.  
*Fissuridea chipolana* Dall.  
*Fissuridea nuclea* Dall.  
*Dentalium ? danai* Meyer.  
*Dentalium attenuatum* Say.  
*Dentalium carolinense* Conrad.  
*Cadulus thallus* Conrad.  
*Nucula proxima* Say.  
*Nucula lapteria* Dall.  
*Leda acuta* Conrad.  
*Leda trochilia* Dall.  
*Yoldia laevis* Say.  
*Glycymeris subovata* Say.  
*Glycymeris americana* de France.  
*Glycymeris duplinensis* Dall.  
*Arca* (*Barbatia*) *adamsi* (Shuttleworth).  
*Arca* (*Natia*) *incile* Say.  
*Arca* (*Scapharca*) *scalaris* Conrad.  
*Arca* (*Scapharca*) *lienosa* Say.  
*Arca* (*Scapharca*) *carolinensis* Wagner.  
*Arca* (*Scapharca*) *improcera* Conrad.  
*Arca* (*Scapharca*) *improcera* subsp. *bulcula* Conrad.  
*Ostrea compressirostra* Say.  
*Ostrea sculpturata* Conrad.  
*Pecten eboreus* Conrad.  
*Plicatula marginata* Say.  
*Mytilus conradinus* d'Orbigny.  
*Thracia transversa* H. C. Lea.  
*Pandora* (*Kennerleyia*) *arenosa* Conrad.  
*Pandora* (*Clidiophora*) *protomos* n. sp.  
*Pandora* (*Clidiophora*) *tuomeyi* n. sp.

- Cuspidaria (Cardiomya) aff. ornatis-*  
*sima* d'Orbigny.  
*Verticordia emmonsii* Conrad.  
*Astarte glenni* Dall.  
*Astarte undulata* Say.  
*Astarte concentrica* Conrad.  
*Crassitellites (Scambula) undulatus* Say.  
*Crassitellites (Crassinella) lunulatus*  
 Conrad.  
*Crassitellites (Crassinella) duplinianus*  
 Dall.  
*Cyrena (Pseudocyrena) dupliniana* Dall  
*Cardita (Carditamera) arata* Conrad.  
*Venericardia (Cyclocardia) granulata*  
 Say.  
*Venericardia (Pleuromeris) tridentata*  
 Say.  
*Venericardia (Pteromeris) perplana*  
 Conrad.  
*Venericardia (Pteromeris) perplana*  
 subsp. *abbreviata* Conrad.  
*Chama corticosa* Conrad.  
*Chama striata* Emmons.  
*Phacoides (Cavilucina) trisulcatus* (Con-  
 rad).  
*Phacoides (Cavilucina) trisulcatus* subsp  
*multistriatus* (Conrad).  
*Phacoides (Lucinica) cribarius* Say.  
*Phacoides (Pseudomiltha) anodonta* Say.  
*Phacoides (Callucina) radians* (Con-  
 rad).  
*Phacoides (Parvilucina) multilineatus*  
 Tuomey & Holmes.  
*Phacoides (Bellucina) tuomeyi* Dall.  
*Codakia (Jagonia) speciosa* (Rogers).  
*Divaricella quadrisulcata* d'Orbigny.  
*Diplodonta nucleiformis* (Wagner).  
*Diplodonta acclis* Conrad.  
*Diplodonta aff. leana* Dall.  
*Erycina carolinensis* Dall.  
*Bornia triangula* Dall.  
*Bornia rota* Dall.  
*Rochefortia stantoni* Dall.  
*Rochefortia stimpsoni* Dall.  
*Sportella constricta* Conrad.  
*Sportella protesta* (Conrad).  
*Anisodonta (Fulcrella) carolina* Dall.  
*Hindsella acuta* Dall.  
*Hindsella aff. carolinensis* Dall.  
*Aligena aequalis* (Conrad).  
*Aligena minor* Dall.  
*Cardium (Trachycardium) ædalium*  
 Dall.  
*Cardium (Cerastoderma) acutilaquea-*  
*tum* Conrad.  
*Cardium (Fragum) medium* Linné.  
*Cardium (Lævicardium) sublineatum*  
 Conrad.  
*Dosinia elegans* Conrad.  
*Transenella carolinensis* Dall.  
*Gafrarium (Gouldia) metastriatum* Con-  
 rad.  
*Macrocallista reposita* Conrad.  
*Callocardia (Agripoma) sayana* (Con-  
 rad).  
*Pitaria filosina* Dall.  
*Chione cribaria* (Conrad).  
*Chione (Lirophora) latilirata* (Conrad).  
*Chione (Timoclea) grus* Holmes.  
*Venus campechiensis* subsp. *rileyi* Con-  
 rad.  
*Gemma magna* Dall.  
*Gemma trigona* Dall.  
*Tellina (Merisca) æquistriata* Say.  
*Tellina (Angulus) macilenta* Dall.  
*Tellina (Angulus) umbra* Dall.  
*Tellina (Angulus) dupliniana* Dall.  
*Strigilla eulykia* n. sp.  
*Metis magnoliana* Dall.  
*Macoma carolinensis* n. sp.  
*Macoma (Psammacoma) holmesii* Dall.  
*Semele carinata* Conrad.  
*Semele subovata* subsp. *duplinensis* Dall.  
*Semele subovata* subsp. *appressa* Dall.  
*Semele nuculoides* (Conrad).  
*Abra aequalis* Say.  
*Tagelus gibbus* Spengler.  
*Donax emmonsii* Dall.  
*Donax cuneola* n. sp.  
*Ensis directus* Conrad.  
*Spisula confragosa* (Conrad).  
*Spisula subparilis* (Conrad).  
*Mulinia congesta* (Conrad).  
*Mulinia congesta* subsp. *magnoliana*  
 Dall.  
*Labiosa lineata* Say.  
*Mya ? arenaria* Linné.  
*Sphenia dubia* (H. C. Lea).  
*Corbula (Alodis) caloosæ* Dall.  
*Corbula (Cuneocorbula) inæqualis* Say.  
*Corbula (Cuneocorbula) cuneata* Say.  
*Panope reflexa* (Say).  
*Saxicava arctica* Linné.  
*Gastrochana cuneiformis* Spengler.  
*Chatoppleura apiculata* Say.  
*Discinisca lugubris* (Conrad).

***Drillia tricaténaria* (Conrad). Plate I, fig. 2.**

*Pleurotoma tricaténaria* Conrad, 1834, Jour. Acad. Nat. Sci. Philadelphia, 1st ser. vol. vii, p. 139.

*Surcula (Pleurotoma) tricaténaria* Conrad, 1863, Proc. Acad. Nat. Sci. Phila-  
 delphia for 1862, vol. xiv, p. 561 (name only).

*Surcula tricaténaria* Conrad, 1864, Meek, Miocene Check List, Smith. Misc.  
 Coll., No. 183, p. 21 (name only).



*Description.*—"Shell subulate, turritid, with longitudinal undulations, which on each whorl of the spire are crossed by three equidistant prominent spiral lines; whorls indented above; indentations finely striated; suture margined by a carinated line; body whorl with about thirteen spiral lines; aperture more than one-third the length of the shell. Length, three-fourths of an inch." Conrad, 1834.

*General Characters.*—Shell rather large, robust. Aperture approximately one-third the total altitude. Whorls probably 8 to 10 in number, concave posteriorly, straight sided or gently convex in front of the fasciole. Body smoothly contracted at the base. Appression of the whorls rather marked. Suture line inconspicuous.

*Protoconch.*—Apex broken away in all available material. Nucleus apparently small.

*Sculpture.*—External sculpture vigorous, both axial and spiral. Axial costae rather strongly elevated, rounded, somewhat undulatory and slightly protractive, 12 to 14 in number on the later whorls, persisting with undiminished strength to the anterior suture but quite abruptly evanescent posteriorly at the margin of the fasciole; on the body whorl, weakening a little in front of the periphery and becoming obsolete before reaching the pillar and, in the older forms, irregular or altogether obsolete toward the aperture; intercostal areas concave, narrower than the costals. Spiral sculpture of broadly arched, rather prominent, primary fillets, uniform in strength on both the costal and the intercostal areas, 9 to 11 in number on the ultima, 3 or 4 upon the penultima, usually, though not always, equal or sub-equal in size and spacing; intercalaries absent in the type but present, as a rule, to the number of 1, 2, or 3 between the primaries of the later whorls; posterior fasciole obscurely undulated anteriorly by the axial sculpture, spirally threaded with 4 to 6 fine, close-set lirae with 1 or 2 stronger cords at the posterior margin, directly in front of the suture line. Anterior canal sculptured with 4 to 6 crowded lirae.

*Aperture.*—Aperture narrow, obliquely lobate, obtusely angulated at the posterior commissure. Labrum somewhat flaring; posterior siphonal notch very narrow, but rather deep. Labium gently excavated at the base of the body whorl. Pillar straight, moderately long, simple. Parietal wall and pillar heavily reinforced. Anterior canal rather long and broad, obtusely truncate at the extremity.

*Dimensions*.—Altitude, 17.5 mm. Maximum diameter, 6.0 mm.

*Type Locality*.—Smithfield, James River, Isle of Wight County, Virginia. *Yorktown Formation*.

*Observations*.—*Drillia tricatena* Conrad is more vigorously sculptured than any of its congeners, even the closely related *Drillia pyrenoides* Conrad. *D. pyrenoides* is, furthermore, a relatively shorter, somewhat stouter shell than *D. tricatena*, with a more rapidly tapering spire and a slightly shorter canal. The axial costae of the former are much more nodose in character than in the latter, while the spirals, both primary and secondary, are fewer in number, more irregular and less prominent. Upon the posterior fasciole, the spiral sculpture is often altogether obsolete, excepting for the sutural cord, which is always less prominent than in *D. tricatena*. Members of this species appear under such various names in the different collections that it has seemed worth while to redescribe and figure the type kindly loaned for the purpose by the Academy of Natural Sciences of Philadelphia.

*Distribution*.—*St. Mary's Formation*. Sycamore, Southampton County, Virginia; 8 to 9 miles and 9 to 10 miles south of Greenville, Pitt County, North Carolina. *Yorktown Formation*. Yorktown, York County; Smithfield, Isle of Wight County; Suffolk and 1 mile northeast of Suffolk, Nansemond County, Virginia. *Duplin Formation*. Natural Well, 1½ miles north of Magnolia, Duplin County; Lake Waccamaw, Columbus County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Drillia precursor* new species. Plate I, fig. 1.

*General Characters*.—Shell small, polished, rather slender, obtusely tapering. Aperture less than half the entire altitude. Whorls 7½ in all, flattened laterally, the profile of the spire feebly crenulated, however, by the axial ribbing. Body whorl broadly rounded, rather strongly constricted at the base. Volutions very closely appressed, delimited by very fine and inconspicuous sutures.

*Protoconch*.—Protoconch small, obtuse. Initial turn smooth and almost entirely immersed in the succeeding volution. Sculpture foreshadowed by the gradual introduction of a keel on the early part of the second nuclear turn,—the spirals increasing in number and prominence so that the close of the whorl is sculptured with

4 strong lirae, the third from the posterior suture being the strongest. Dividing line between conch and protoconch very sharp, marked by the abrupt reduction of the spiral sculpture and the even more abrupt appearance of the axial sculpture.

*Sculpture.*—*Axials* low and rounded, 13 or 14 to a turn, least prominent upon the body, obsolete upon the pillar; interaxial areas broadly concave, usually wider than the axials. Spirals somewhat irregular, wide, flattened, little elevated bands, separated by narrower interspaces, 4 or 5 in number on the earlier whorls, 10 or 12 on the ultima and pillar. Posterior fasciole distinct, sculptured with 3 low, flat spirals separated by linear interspaces, and with a prominent rounded thread revolving anterior to the suture; a much less prominent liration also developed just posterior to the suture.

*Aperture.*—Aperture narrow, obliquely lenticular, acutely angulated at the posterior commissure. Labrum broadly and feebly arcuate. Siphonal notch narrow and not very deep. Labium feebly convex. Pillar straight, simple. Parietal wall and pillar heavily reinforced. Anterior canal short, rather broad, feebly emarginate.

*Dimensions.*—Altitude, 7.2 mm. Maximum diameter, 3.0 mm.

*Type Locality.*—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Duplin Formation.*

*Observations.*—It seems quite probable that this late Miocene *Drillia* is the ancestor of the Caloosahatchie Pliocene form, *Drillia piscator* Dall. In general aspect, it is a more highly polished shell with a less strongly defined sculpture. In detail, it differs from *D. piscator* in the nuclear characters, the more numerous axial ribs, which are more prominent especially on the ultima, the narrower and more elevated spicals and the stronger and more angular liration revolving anterior to the suture.

*Distribution.*—*Duplin Formation.* Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Drillia sumterensis* new species. Plate I, fig. 3.

*General Characters.*—Shell rather small for the genus, slender, tapering. Component volutions 10 in number. Whorls of spire gently convex, regularly increasing in diameter. Body less than half as high as the entire shell, rounded like the later whorls of

the spire, smoothly constricted at the base. Volutions so closely appressed against each other that the suture line is undulated by the costæ of the preceding turn.

*Protoconch*.—Protoconch very small and smooth, twice-coiled. Initial turn for the most part submerged in the succeeding volution. Second turn feebly inflated. Opening of conch marked by the abrupt appearance of the axial sculpture.

*Sculpture*.—Axial ribs 8 or 9 to the whorl, broad and undulatory, extending from the anterior margin of the fasciole to the suture and, on the final volution, well down on to the pillar; incrementals perceptible with a hand lens. Spirals low, broad, inconspicuous lirations, numbering 7 to 9 to the whorl, separated by interspaces of about half their own width; fortuitous secondaries occasionally intercalated; pillar threads more rounded and more prominent than those behind them; fasciole well defined, feebly concave, slightly corrugated by the costæ, sculptured with 5 to 7 very faintly impressed revolving lines and oblique incrementals.

*Aperture*.—Aperture narrow, lobate, acutely angulated at the posterior commissure. Outer lip gently arcuate, not sharply constricted at the base of the body. Siphonal notch rather shallow, symmetrically disposed upon the fasciole. Labium excavated. Pillar straight, simple. Parietal wall and pillar wash heavy. Anterior canal very short, moderately broad, obtusely truncate.

*Dimensions*.—Altitude, 14.0 mm. Maximum diameter, 5.0 mm.

*Type Locality*.—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Duplin Formation*.

*Observations*.—*Drillia sumterensis* closely approaches *Mangilia* in delicacy of outline and ornamentation. The character of the anterior canal is, however, more suggestive of *Drillia*.

*Distribution*.—*Duplin Formation*. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Cancellaria tabulata* new species. Plate I, fig. 9.

*General Characters*.—Shell rather large and heavy, conspicuously scalariform. Aperture a little more than half as high as the entire shell. Conchal volutions 5 in number, widely tabulated, the whorls of the spire flattened laterally, the body broadly rounded and abruptly constricted at the base. Suture distinct, feebly impressed, undulated by the costal of the preceding volution.

*Protoconch*.—Protoconch rather small, smooth, thrice-coiled, the component whorls increasingly rapidly in diameter, altitude, and degree of inflation. Dividing line between conch and protoconch indicated by the abrupt initiation of the axial sculpture.

*Sculpture*.—Whorls of conch latticed. Axial sculpture of narrow, rounded, elevated ribs, irregularly spaced and, on the ultimar and penultimar whorls, varying from 16 to 26 in number; costals of spire continuous from suture to suture, strongly retractive on the shoulder, weakening perceptibly posteriorly; on the ultima, persisting with diminishing strength well down on to the pillar; incrementals well developed. Spiral sculpture often more prominent than the axial; lirations flat topped, well elevated threads, separated by interspaces a little wider than the lirae and just about equal to the intercostal areas; the spirals overriding the costæ at their intersection, producing a series of elevations which would appear granular in a more closely sculptured shell; normal number of primaries on the sides of the whorls of the spire, 3; on the body and pillar, 8 to 10; anterior primary of each volution following the peripheral angle; angle rounded off on the final half turn and, at the aperture, almost or altogether obsolete; a single secondary occurring midway between the periphery and the suture; other secondaries intercalated upon the body whorl; anterior fasciole threaded with 3 or 4 subequal, closely spaced lirae.

*Aperture*.—Aperture rather narrow for the group, oblique. Outer lip arcuate, lirate within; lirae approximately 9 in number, corresponding in position to the secondaries on the body whorl. Columella quite strongly excavated at the base of the body. Parietal wash not sufficiently heavy to conceal the basal sculpture. Pillar quite long and straight. Columellar plications narrow, oblique, sub-parallel and almost equally spaced, increasing rapidly in prominence from the anterior to the posterior; anterior fold marginal.

*Umbilicus*.—An umbilical chink usually open, though occasionally concealed by callous.

*Dimensions*.—Altitude, 29.62 mm. Maximum diameter, 17.0 mm.

*Type Locality*.—5 miles northeast of Smithfield, James River, Isle of Wight County, Virginia. *Yorktown Formation*.

*Observations*.—*Cancellaria tabulata* is separated from the later but closely allied *Cancellaria conradiana* Dall by the lower spire, the stouter body whorl, the much wider, much more sharply defined shoulder, and the more loosely reticulated sculpture.

*Distribution.*—*Yorktown Formation.* 5 miles northeast of Smithfield, James River, Isle of Wight County, Virginia. *Duplin Formation.* Natural Well,  $1\frac{1}{2}$  miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Mitra dalli* new species. Plate I, figs. 4, 8.

*Mitra* sp. indet., Dall, 1890, Trans. Wagner Free Inst. Sci., Philadelphia, vol. iii, pt. ii, p. 93.

*Original Description.*—"A single specimen too worn to name was found in the Caloosahatchie marl. It has about sixteen ribs and in general resembles a slender *M. Wandoensis*, but just below the periphery of the whorl is a marked groove, channelled and cutting the ribs as well as the interspaces. On the earlier whorls this channel revolves a short distance behind the suture, which thus appears double. This character will enable the species to be recognized when perfect specimens are found. There are three folds on the columella and the shell is about the size of the next species. (*Mitra wilcoxii*.)" Dall, 1890.

*General Characters.*—Shell small, slender, terminating obtusely. Aperture about one-third the total altitude. Whorls of conch  $6\frac{1}{2}$  in number, flat-sided, tabulated behind, wound about one another like a bandage with the posterior edge folded under. Body rather abruptly constricted at the base. Sutures deeply impressed.

*Protoconch.*—Nucleus smooth, papillate, coiled  $1\frac{1}{2}$  times.

*Sculpture.*—Axial sculpture of about 18 sharp, narrow, elevated, slightly arcuate costæ which persist with undiminished strength from suture to suture and, on the ultima, as far as the canal. Spiral lirations, for the most part, discernible only under magnification; the spiral sculpture, of the apical whorls, with the exception of the pre-sutural groove, confined to the intercostal areas; lirations low, broad, and flattened, 5 to 8 to the whorl as a rule, separated by narrower interspaces; number and character of the lirations on the portion of the body whorl posterior to the impressed groove similar to that of the earlier whorls; spirals much more prominent anterior to the groove and visible without magnification, 4 to 6 in number, exclusive of those upon the canal, unequal in size and strength, and for the most part, separated by linear interspaces;

anterior fasciole adorned with about 4 rounded, elevated, close-set cords.

*Aperture*.—Aperture very narrow, somewhat crescentic. Posterior commissure well rounded. Outer lip arcuate, smooth within. Columella concave, bearing 3 folds, of which the two posterior are the strongest. Anterior canal short, recurved, slightly emarginate.

*Dimensions*.—Altitude, 8.0 mm. Maximum diameter, 2.5 mm.

*Type Locality*.—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Duplin Formation*.

*Observations*.—The species is characterized not only by the spiral furrow but also by the slender, tabulated outline of the whorls. The type has been compared with the form from which Dall's description was made and there is no doubt of their identity. The young of the species are stout little cones with well developed sculpture and an angular whorl.

*Distribution*.—*Yorktown Formation*. Drainage ditch 1 mile northeast of Suffolk, Nansemond County, Virginia. The young individual collected at this locality is referred rather doubtfully to this species.

*Duplin Formation*.—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Caloosahatchie Formation*. Caloosahatchie River, Florida.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Mitromorpha mitrodita* new species. Plate I, fig. 7.

*General Characters*.—Shell very small, fusiform, the greatest diameter falling at or just anterior to the median line of the shell. Aperture nearly half the total altitude. Whorls of conch  $4\frac{1}{2}$  in number, regularly increasing in diameter, those of the spire somewhat trapezoidal in outline, the body broadly arcuate. Sutures inconspicuous, undulated by the costæ of the preceding whorl.

*Protoconch*.—Protoconch twice coiled. Initial turn minute, inflated, immersed only at the tip. Succeeding volution relatively high, broadly convex. Opening of conch indicated by the abrupt appearance of the axial and spiral ornamentation.

*Sculpture*.—Axial sculpture less conspicuous than the spiral; costæ confined largely to the earlier whorls and tending to become obsolete on the ultima and penulta, 9 to 10 in number, low, rounded, and undulating, continuous from suture to suture but most promi-

nent directly behind the anterior suture. Spirals equisized and equispaced, narrow, sharp, much elevated liræ, prominent alike on the costal and intercostal areas; lirations 4 in number on each of the apical whorls, 12 or 13 upon the body and pillar which are not well differentiated; the wider interspaces striated with fine, even, close-set incrementals; fasciole indicated by the slightly wider interspace between the posterior and the next succeeding spiral.

*Aperture.*—Aperture narrow, sinuous, acutely angulated posteriorly. Outer lip broadly arcuate, feebly lirate within. Columella excavated at the base of the body whorl. Parietal and pillar wash rather thin. Pillar moderately long, slightly twisted, bearing 2 equal, oblique, and rather feeble plications, midway between the anterior and posterior canals. Anterior canal broad and open, obtusely truncated at the extremity.

*Dimensions.*—Altitude of type, 5.5 mm. Maximum diameter, 2.0 mm. Altitude of average individual, 3.7 mm. Maximum diameter, 1.5 mm.

*Type Locality.*—Natural Well, Duplin County, North Carolina.  
*Duplin Formation.*

*Observations.*—*Mitromorpha mitrodita* is separated from *M. pygmaea*, its nearest southern relative, by the more slender outline, and the broader and less numerous costals, which, in *mitrodita*, are not confined exclusively to the early whorls but undulate the penult and even the ultima. *M. smithfieldensis* Olsson, the Yorktown analogue, differs in the less numerous conchal turns, the more distant axial sculpture, and the lower number of body spirals.

*Distribution.*—*Duplin Formation.* Natural Well, 1½ miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

The species is rare and, even when present, is so small that it is easily overlooked.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Phos sloani* new species. Plate I, fig. 10.

*General Characters.*—Shell slender; spire greatly elevated for the genus. Aperture less than two-thirds the total altitude. Whorls closely appressed, almost flat, though apparently somewhat convex because of the greater prominence of the axial ribs near the median line of the whorl. Body whorl gently rounded,



rather sharply constricted at the base. Suture distinct, not conspicuous, gently undulated by the axial ribs of the preceding whorl.

*Protoconch*.—Protoconch small, smooth, acutely tapering, paucispiral, although the exact number of turns can not be determined because of the decortication of the apex.

*Sculpture*.—Axial sculpture of prominent, rounded ribs and of incrementals visible only under magnification; costæ 7 or 8 to the whorl, rounded, though sharply defined, conspicuous elevations, which, on the spire, persist from suture to suture, although strongest on the periphery; body costæ rounded on the summits, the sides almost vertical, gradually flattening as they approach the canal; prominence of the costæ greatly increased by the peculiar spiral lirations which cross them. Primary spirals 3 or 4 in number upon the whorls of the spire, broad and low and very flat in the intercostal areas and on the sides of the costæ; liræ abruptly thickening, however, upon the summits of the costals thereby throwing the intercostal areas into relief and apparently increasing the elevation of the costæ; secondary spiral lirations narrow, flat bands less than one-half as wide as the primaries and separated from them by interspaces the width of the former; secondaries not increasing in prominence as they cross the axials; posterior fasciole rather wide, sculptured with an anterior secondary, 2 or 3 primaries of uniform elevation and without intercalated secondaries, together with a broad, pre-sutural ribbon equal to the primaries in altitude and exceeding them in breadth; body whorl ornamented with 12 primaries; secondaries intercalated on the posterior portion but absent anteriorly; anterior fasciole differentiated but not prominently keeled, sculptured with 5 to 8 crowded liræ.

*Aperture*.—Aperture ovate-elongate. Labrum arcuate, furnished with 8 or 9 sharp plications upon the surface. Columella concave, smooth, calloused. Canal short, slightly recurved, emarginate.

*Dimensions*.—Altitude, 20.7 mm. Maximum diameter, 7.2 mm.

*Type Locality*.—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Duplin Formation*.

*Observations*.—*Phos sloani* is known only from Sumter County, South Carolina, and is quite unlike any described form. It is characterized by the peculiar, abrupt increase in the prominence of the spirals as they mount the summit of the costals, so that the intercostals have the appearance of being smoothly scooped.

We have the pleasure of naming this interesting species in honor of Dr. Earle Sloan, of Charleston, South Carolina, whose name will always be so pleasantly associated with the development of the Geological Survey of South Carolina.

*Distribution*.—*Duplin Formation*. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Alectrion neogenensis* new species. Plate I, figs. 5, 6.

*General Characters*.—Shell elevated, slender, turritid. Body whorl slightly more than half the altitude. Conchal whorls 6 in number, feebly convex, the ultima abruptly constricted at the base. Suture line distinct, slightly impressed, undulated by the costals of the preceding volution.

*Protoconch*.—Protoconch of 2 small, smooth, button-like whorls, the earlier turn submerged in the later.

*Sculpture*.—Axial and spiral sculpture normally initiated simultaneously; in some individuals, however, the costals apparently preceding the spirals. Costals, when well established, narrow, rounded, and moderately elevated, 10 to 14 in number on the later volutions; for the most part, equi-size, persistent with uniform strength from suture to suture and separated by intercostals of approximately equal width. Spirals regular as a rule, in size and spacing, from the nucleus to the anterior canal, very low, rather broad, overriding the costal and the intercostal areas with uniform strength, 6 in number on the later whorls of the spire, and 10 or 12 on the body,—the two anterior narrow, and more elevated than those behind; interspirals equal to or a little narrower than the spirals. Base of body margined by profound sulcus on which the incremental sculpture is well marked. Anterior fasciole bearing some half dozen crowded spirals.

*Aperture*.—Aperture not quite one-third the total altitude, obliquely ovate. Outer lip sub-varicose, flaring anteriorly, though abruptly contracted at the canal; inner denticles sharp little ridges at right angles to the margin, uniformly spaced and about 6 in number. Columellar lip sigmoidal, heavily calloused, the outer margin of the callous sharply defined. A rather prominent transverse ridge developed near the posterior commissure, and shorter irregular denticles toward the anterior canal. Anterior canal short, recurved, and deeply emarginate.

*Dimensions*.—Altitude, 12.1 mm. Maximum diameter, 6.0 mm. Diameter at right angles to the maximum diameter, 5.0 mm.

*Type Locality*.—Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina. *Waccamaw Formation*.

*Observations*.—The *Alectrion lapontierei* of Dall is quite similar in outline but runs smaller, and has fewer, much narrower, and more distant spirals.

*Distribution*.—*St. Mary's Formation*. 4 miles northwest of Williamston, Martin County; 1 mile west of Wilson in Hominy Swamp, Wilson County, North Carolina. *Yorktown Formation*. Yorktown, York County;  $1\frac{1}{2}$  miles north of Suffolk, 1 mile north-east of Suffolk, and at Suffolk,  $\frac{1}{2}$  mile below the Suffolk water works dam, Nansemond County, Virginia. Colerain Landing on the Chowan River, Bertie County, North Carolina. *Duplin Formation*. 2 miles below Lumberton, and 4 or 5 miles below Lumberton, Robeson County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Waccamaw Formation*. Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina.

Although the type of this widely distributed little species comes from the *Waccamaw*, it occurs most commonly in the *Yorktown* and *Duplin* Formations.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Anachis stylola* new subspecies *obsoleta*. Plate II, figs. 7, 9, 12.

*General Characters*.—Shell moderately tall, varying quite widely in degree of slenderness. Spire acute, attenuated. Aperture sometimes less than one-third the total altitude. Whorls 8 to 10 in number, regularly increasing in size, minutely tabulated posteriorly, the preceding volution, correspondingly undercut anteriorly. Early whorls of conch strongly carinated, the keel moving forward from its initial position at approximately the median horizontal, till, by the end of the first whorl, it directly overhangs the suture and conspicuously coronates the succeeding turn, gradually, however, becoming lower and less prominent, and usually reduced to the normal plane of the spire by the end of the third whorl. Suture distinct, inconspicuous; sulcus outlining the periphery of the preceding whorl often visible behind it.

*Protoconch*.—Protoconch smooth, including  $1\frac{1}{2}$  to 2 whorls, the first half turn largely immersed, the second quite strongly globose posteriorly, becoming decreasingly convex anteriorly.

*Sculpture*.—Axial sculpture appearing, as a rule, on the first coil of the conch in the shape of faint incremental striæ, which rapidly strengthen and recur at more and more regular intervals until, by the beginning of the second conchal whorl, there is, in the majority of individuals, a well established axial sculpture of 16 to 18 narrow, obtuse, slightly arcuate riblets which are uniform in strength on the early whorls, from the posterior shoulder to the anterior keel which they delicately crenulate; axial sculpture varying in degree of development and persistence from that of the *A. styliola sensu stricto* to an almost smooth type in which the costals are reduced to feeble undulations faintly visible just posterior to the suture line and even feebler wavelets anterior to the suture. Spiral sculpture confined, as a rule, to the base of the body whorl, the pillar, and the anterior canal; periphery of ultima usually outlined by a shallow linear sulcus; base of ultima usually sculptured with 6 to 8 low, half obsolete threads separated by linear interspaces, and, in front of them, 2 less feeble, more widely separated spirals; lirations upon the pillar and anterior siphonal canal normally 9 or 10 in number, well rounded, rather prominent, and close-set; faint traces of spiral liræ visible under high magnification upon other portions of the surface but nowhere sufficiently strong to affect the general aspect of the shell.

*Aperture*.—Aperture narrow, lenticular, angulated posteriorly. Outer lip feebly arcuate, obscurely varicose in the adult forms and transversely lirate within. Inner lip contracted at the base of the body whorl. Parietal wall glazed, more or less corrugated in harmony with the spiral sculpture; margin of reflected callous sharp, and standing apart from the pillar wall. Anterior canal moderately long for the genus, recurved, obliquely emarginate.

*Dimensions*.—Altitude, 16.5 mm. Maximum diameter, 4.6 mm.

*Type Locality*.—Natural Well, 1½ miles north of Magnolia, Duplin County, North Carolina. *Duplin Formation*.

*Observations*.—The diagnostic characters of the subspecies are the relatively shallow sutural channel and the more or less obsolete sculpture, both axial and spiral. It is a rather common little form in the *Duplin* of the Carolinas.

*Distribution*.—*Duplin Formation*. Natural Well, 1½ miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Anachis sumterensis* new species. Plate II, figs. 2, 6.

*General Characters*.—Shell small, slender, fusiform, including from 6 to 7 volutions. Whorls of spire keeled and slightly overhanging. Body whorl gently and evenly rounded, approximately half as high as the entire shell. Posterior margins closely appressed. Suture distinct.

*Protoconch*.—Nucleus small, erect, sub-globular, including  $1\frac{1}{2}$  volutions. First turn and part of second smooth. Last quarter turn sculptured with very fine, microscopic, axial striations.

*Sculpture*.—Axial sculpture of about 10 longitudinal undulations which are most conspicuous upon the keel, evanescent above and below and becoming almost or altogether obsolete upon the ultima; growth lines confined to the interspaces between the spirals. Spiral sculpture abruptly initiated at the origin of the conch; lirations flattened, rather broad, conspicuous alike on the costal and the intercostal areas, 4 in number on the early whorls of the spire, the anterior the most prominent, so strong indeed, that it forms a keel which overhangs the succeeding turn; one or 2 additional spirals introduced on the later volutions between the keel and the anterior suture; lirations on the body 6 or 7 in number, similar in character to those upon the spire; interspaces approximately the width of the spirals, straight-sided and microscopically striated with fine, close-set incrementals; pillar and canal adorned with about double the number of liræ present upon the body whorl, these liræ differing, however, from the body spirals in being narrower, slightly rounded and much more crowded.

*Aperture*.—Aperture a rounded, irregular oval, angulated posteriorly. Outer lip strongly arcuate, faintly lirate within. Inner lip excavated, thinly calloused. Canal rather short for the genus, wide and open, truncate anteriorly.

*Dimensions*.—Altitude, 5.5 mm. Maximum diameter, 2.0 mm.

*Type Locality*.—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Duplin Formation*.

*Observations*.—The overhanging whorls suggest the young of *Anachis styliola* Dall, but the former is much more angular in outline and is sculptured with numerous narrow riblets and ill-defined spirals while in the latter, the axial costals are relatively few in number and broad and undulatory in character, while the spirals are strong and regular.

*Distribution*.—*Duplin Formation*. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

**Collections.**—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Anachis anomala* new species. Plate II, fig. 3.

**General Characters.**—Shell small, heavy, rather stout, fusiform. Volutions  $5\frac{1}{2}$  to 6, slightly convex, narrowly tabulated, rapidly increasing in size. Body smoothly constricted at the base. Aperture a little less than one-half the total altitude. Suture line inconspicuous, impressed.

**Protoconch.**—Apex somewhat decorticated so that it is impossible to determine all of the characters of the earlier whorls. Protoconch probably small, smooth, papillate, and pauci-spiral.

**Sculpture.**—First whorl of conch apparently smooth; second whorl sculptured with about 16 narrow, rounded, axial riblets which disappear quite abruptly on the penultima. Spiral sculpture, for the most part, wanting though faintly impressed lines may occasionally be caught on the second whorl under magnification and a faint but distinct linear sulcus follows directly behind the suture from the second turn to the last; two stronger impressed spirals directly in front of the periphery of the ultima; pillar and canal sculptured with 9 straight sided, proximate grooves sufficiently deep to be visible with the unaided eye.

**Aperture.**—Aperture irregularly elongate. Outer lip straight, somewhat flaring anteriorly, subvaricose, thickened and quinque-denticulate within,—the denticles decreasing in prominence anteriorly; posterior commissure filled with callous. Labium broadly constricted at the base of the body. Pillar straight, simple, heavily calloused, slightly rugose near the outer margin of the wash,—the rugæ corresponding in position to the external sculpture. Canal short, open, slightly recurved, abruptly truncate and broadly emarginate anteriorly.

**Dimensions.**—Altitude, 5.0 mm. Maximum diameter, 2.5 mm.

**Type Locality.**—Natural Well, Duplin County, North Carolina.

**Duplin Formation.**

**Observations.**—*Anachis anomala* is doubtless a near relative of the protean *A. avara* of Say. Though very similar in general aspect and outline, the absence of an axial sculpture upon the first and the last whorl is sufficient to readily differentiate it specifically.

**Distribution.**—**Duplin Formation.** Natural Well,  $1\frac{1}{2}$  miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place,

5 miles southeast of Mayesville, Sumter County, South Carolina. The species is rare even within the apparently restricted area within which it occurs.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Astyris communis* new subspecies *carolinensis*. Plate II, fig. 11.

*General Characters*.—Shell rather large for the genus, stout, rudely biconic. Whorls approximately 8 in number, tapering rapidly to an acute apex which is somewhat decorticated so that the characters of the protoconch are obscured. Body whorl between one-half and two-thirds of the total altitude, obtusely angulated at the periphery excepting near the aperture where it is broadly rounded and scarcely constricted. Whorls of spire trapezoidal in outline. Suture impressed; edge of whorl in front of it sharp, but closely appressed.

*Protoconch*.—Protoconch very imperfectly preserved.

*Sculpture*.—External surface unsculptured excepting for some 15 linear sulci upon the pillar and anterior canal.

*Aperture*.—Aperture a little less than one-half the total altitude, rather narrow, angulated behind. Outer lip a sinistral hook, feebly emarginate posteriorly, thickened and dentate within; denticles 8 in number in the type, the posterior rather smaller and somewhat removed from the 7 in front of it which are equisize and equispaced and extend well around the anterior curvature. Columella rather sharply excavated at the base of the body, simple, excepting for an obscure marginal fold. Parietal wall glazed, a drop of callous deposited just in front of the posterior angle, feebly rugose at the initiation of the pillar. Anterior canal straight or very slightly recurved, deeply emarginate.

*Dimensions*.—Altitude, 13.3 mm. Maximum diameter, 6.1 mm.

*Type Locality*.—Tilly's Lake, South Carolina. *Waccamaw Formation*.

*Observations*.—The subspecies *carolinensis* is isolated from the *communis* s. s. by the absence of the minute tabulation in front of the suture, and the longer and straighter anterior canal. In many of the collections and check-lists, forms similar to those which have been included under this subspecies are listed under *Astyris profundus* or its subspecies *minor* and *permagna*. The type of *profundus* was dredged in eight hundred and five fathoms. The body whorl is more rounded than in any of the Tertiary indi-

viduals with which it is confusable, the nucleus has more turns, and furthermore, there is a microscopically fine but very distinct and regular spiral sculpture developed on the earlier whorls of the conch, which has never been perceptible on any of the fossil individuals. It would be indeed remarkable to find in the Tertiary sands the representatives of a recent deep water species associated with limpets, littorinas, clams and other characteristic denizens of the littoral zone. There is, however, no reliable evidence that we are in the face of any such phenomenon. The type is in the Collections of the United States National Museum and has been listed as *Astyris profundus* var. *permagna*. As *permagna* has never been described nor figured, the label name has been abandoned in order to avoid the confusion of applying so suggestive an adjective to a subspecies of approximately the same dimensions as the species *sensu stricto*.

*Distribution*.—*Duplin Formation*. Natural Well,  $1\frac{1}{2}$  miles north of Magnolia, Duplin County; Lake Waccamaw, Columbus County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Waccamaw Formation*. Walker's Bluff, Bladen County. Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina. Tilly's Lake, Horry County, South Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Urosalpinx phrikos* new species. Plate IV, figs. 2, 4, 6, 7.

*General Characters*.—Shell of medium size, fusiform, the greatest diameter falling very close to the median line. Aperture approximately half the total altitude. Component volutions normally 7 in number in the adult conch. Whorls of spire convex, obscurely shouldered, decreasing rapidly in size toward the acute apex. Body whorl rather abruptly constricted at the base. Posterior fasciole closely appressed against the preceding volution. Suture line slightly impressed, undulated.

*Protoconch*.—Protoconch including  $1\frac{1}{2}$  small, smooth, somewhat flattened whorls. First half turn partially submerged in the succeeding volution. Differentiation between conch and protoconch very sharp.

*Sculpture*.—Both axial and spiral sculpture initiated at the beginning of the first whorl of the conch. Axial sculpture of 9 or 10 broad, rounded, prominent ribs which tend to evanesce



upon the posterior fasciole and canal; intercostal areas broadly convex and approximately equal in width to the costals; incremental sculpture consisting of minute, over-lapping lamellæ most conspicuous upon the fasciole, and at the intersection with the spirals. Primary spirals rather low, uniform, broadly arched lirations, 3 or 4 in number on the penult and 14 to 16 upon the ultima and canal; secondaries regularly intercalated; tertiaries rarely.

*Aperture*.—Aperture rather narrow, pyriform. Labrum arcuate, sub-varicose during the development of the costals; outer edge often minutely crenulated; inner transverse lirations analogous to external secondaries. Labium gently excavated at the base of the body, somewhat thickened but not plicate at the entrance to the canal. Anterior canal rather long, slightly twisted, with proximate margins and a shallow terminal notch.

*Umbilicus*.—Umbilical chink almost or entirely concealed by the parietal callous.

*Dimensions*.—Altitude, 19.7 mm. Maximum diameter, 10.4 mm. Diameter at right angles to the maximum diameter, 9.5 mm. Dimensions of a less perfect individual: altitude, 23.3 mm. Maximum diameter, 13.1 mm. Diameter at right angles to the maximum diameter, 12.1 mm.

*Type Locality*.—Natural Well, Duplin County, North Carolina. *Duplin Formation*.

*Observations*.—*Urosalpinx phriknos* is remarkable among its congeners for its relatively few but uniform and vigorous axial costæ.

*Distribution*.—*St. Mary's Formation*. 3 miles southwest of Frog Level, Pitt County. Wilson, Wilson County, North Carolina. *Duplin Formation*. Natural Well, 1½ miles north of Magnolia, Duplin County; 4 to 5 miles below Lumberton and 1½ miles northeast of Fairmont, Robeson County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

***Epitonium muldrowi* new species.** Plate II, fig. 10.

*General Characters*.—Outline slender, whorls enlarging but slowly. Apex of spire broken away; remaining volutions 4½ in number, convex, barely contiguous, very strongly constricted at the deeply impressed sutures.

*Protoconch*.—Protoconch not preserved.

*Sculpture*.—Axial varices equisize, 8 to the whorl; on the later turns, made up of four heavy lamellæ which open up slightly on the medial portion of the whorl, abruptly contracting both vertically and horizontally about midway between the periphery of the whorl and the posterior suture, thus giving to the whorl a somewhat shouldered appearance; varices continuous, fused at the suture line, set somewhat obliquely so that each longitudinal series describes about half a turn around the axis of the shell; intervarical spaces smooth with not even a suggestion of spiral sculpture.

*Aperture*.—Aperture entire, sub-circular. Outer lip well rounded, margined by the terminal varix, which, in the type, is equal in size to the other varices of the whorl. Inner lip less strongly rounded than the outer and less heavily enameled.

*Dimensions*.—Altitude, 6.0 mm. Maximum diameter, 3.0 mm.

*Type Locality*.—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Duplin Formation*.

*Observations*.—Though only a single specimen has been preserved and that a mutilated one, yet the form seems sufficiently distinct to warrant description. The nearest of kin among the *Epinonia* of the area is, apparently, *Epitonium sayana* Dall. *E. muldrowi* may, however, be separated at a glance by the much heavier varices.

*Distribution*.—*Duplin Formation*. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Collections*.—Johns Hopkins University.

*Melanella bartschi* new species. Plate II, fig. 1.

*General Characters*.—Shell imperforate, straight, quite large for the genus, elongate-conic in outline. Spire subulate, the body a little more than one-third the altitude of the entire shell. Whorls closely appressed, flattened, regularly increasing in size, approximately 15 in number. Body evenly rounded in the adults, more or less obtusely angulated in the young and adolescents. Suture distinct but inconspicuous.

*Protoconch*.—Apex broken in all available material.

*Sculpture*.—External surface smooth, polished.

*Aperture*.—Aperture holostomous, obliquely sub-ovate, moderately wide, acutely angulated posteriorly. Peristome not continuous. Outer lip arcuate, feebly contracted directly in front

of the posterior suture, expanding again away from the suture, slightly patulous anteriorly. Columella quite strongly concave at the base of the body. Inner lip reflexed and fused with the heavy parietal wash.

*Dimensions*.—Altitude, 16.0+ mm. Maximum diameter, 4.2 mm.

*Type Locality*.—Magnolia, Duplin County, North Carolina.

*Duplin Formation*.

*Observations*.—*Melanella bartschi* has been confused in the reference collections with *Melanella conoidea* Kurtz and Stimpson. It is, however, double the size of *M. conoidea*, and has a relatively higher and more compressed body and fewer volutions in proportion to the altitude. The variation in relative dimensions is quite wide. The young are perfect little cones,—the sides of the spire sloping uniformly to the sharply angulated periphery of the body.

We have the pleasure of naming the species in honor of Dr. Paul Bartsch, of the U. S. National Museum, who has so critically monographed the *Melanellidae* of the West Coast.

*Distribution*.—*Duplin Formation*. Magnolia and the Natural Well, 1½ miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina.

*Melanella bartschi* is quite common in the *Duplin* of the Carolinas.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

***Melanella magnoliana* new species.** Plate II, fig. 8.

*General Characters*.—Shell imperforate, straight, of moderate size and moderately stout for the genus. Elongate conic in outline. Spire subulate, the body a little more than one-third the total altitude. Whorls closely appressed, flattened, regularly increasing in size, 12 in number, including the protoconchal turns. Body whorl broadly rounded. Sutures distinct, even faintly impressed toward the apex.

*Protoconch*.—Nuclear turns minute, not more than 2 in number, differentiated only by their very slight convexity.

*Sculpture*.—External surface highly polished, entirely devoid of sculpture.

*Aperture*.—Aperture holostomous, rather narrow, obliquely subovate in outline, acutely angulated posteriorly. Outer lip feebly

contracted directly in front of the posterior suture, expanding again away from the suture, quite strongly reflexed and patulous anteriorly. Columella obliquely contracted at the base of the body. Inner lip widely reflexed, fused with the parietal callous.

*Dimensions*.—Altitude, 7.5 mm. Maximum diameter, 2.5 mm.

*Type Locality*.—Magnolia, Duplin County, North Carolina.

*Duplin Formation*.

*Observations*.—*Melanella magnoliana* is most closely allied, apparently, to *Melanella eborea* Conrad. It differs from the latter, however, in its rather more slender outline, more numerous whorls in proportion to the altitude, and the more widely reflexed, and patulous anterior portion of the aperture.

*Distribution*.—*Duplin Formation*. Magnolia and the Natural Well, 1½ miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Waccamaw Formation*. Walker's Bluff, Bladen County, North Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Strombiformis dalli* new species. Plate II, fig. 5.

*Eulima (Leiostraca) rectiuscula* Dall, 1890, Trans. Wagner Free Inst. Sci. Philadelphia, vol. iii, pt. i, p. 160 (ex parte).

*General Characters*.—Shell imperforate, moderately tall and exceedingly slender. Altitude of body approximately one-half that of the entire shell. Whorls closely appressed, slightly flattened dorso-ventrally, feebly constricted at the suture lines, 10 to 11 in number. Spire subulate, faintly undulated by the barely perceptible medial convexity of the whorls. Body evenly and very gently curved. Base and aperture very long drawn out. Sutures obscure.

*Protoconch*.—Nuclear turns minute, probably 2 in number, differentiated only by their relative inflation.

*Sculpture*.—External surface smooth, lustrous.

*Aperture*.—Aperture holostomous, sub-ovate, acutely angulated posteriorly. Outer lip approximately vertical, patulous and feebly reflexed anteriorly. Inner lip oblique, reflexed, fused with the parietal callous.

*Dimensions*.—Altitude, 9.8 mm. Maximum diameter, 1.95 mm.

*Type Locality*.—Caloosahatchie River, Florida. *Caloosahatchie Formation*.

*Observations.*—In 1889,\* Dall referred to *Eulima* (*Leiostraca*) *stenostoma* Sars, a form collected off Fernandina, Florida. In 1890 (see synonymy), he separated it under the name of *Eulima* (*Leiostraca*) *rectiuscula* and united with it some forms collected from the Caloosahatchie. The Tertiary shells are, however, quite distinct from the recent individuals in question: the whorls of the latter are much more numerous,—probably 15 in a perfect specimen of the Recent shell instead of only 11 or 10 as in the fossil,—and the spire includes fully two-thirds of the total altitude of the shell instead of not more than half of it.

*Distribution.*—*Yorktown Formation.*  $\frac{1}{2}$  mile below Suffolk water works dam, Nansemond County, Virginia. *Duplin Formation.* Natural Well,  $1\frac{1}{2}$  miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Caloosahatchie Formation.* Caloosahatchie River, Florida.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Cæcum flemingi* new species. Plate IV, fig. 5.

*General Characters.*—Shell a gently arcuate tube, slightly smaller at the anterior end than at the posterior.

*Protoconch.*—Protoconch not preserved. Plug unguulate—a minute, dextrally truncated cone set well to the right of the median vertical.

*Sculpture.*—External surface smooth excepting for microscopically fine, irregular, incremental striæ.

*Aperture.*—Aperture oblique to the horizontal axis,—the margin faintly, but perceptibly, contracted.

*Dimensions.*—Altitude, 3.8 mm. Diameter of aperture, 1.2 mm. Diameter of posterior extremity, 1.0 mm.

*Type Locality.*—Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina. *Waccamaw Formation.*

*Observations.*—The only constant difference which separated *Cæcum flemingi* from *Cæcum virginianum* Meyer, of the Yorktown Formation, is the contraction of the anterior aperture. No trace of this is discernible in any one of the many Yorktown individuals examined, while, on the other hand, it is a diagnostic of every perfect adult from the Duplin and Waccamaw. The Yorktown forms, furthermore, run a little larger, and perhaps

\* Dall, 1889, Bull. U. S. National Museum, No. 37, p. 126.

a little less arcuate. The greater dimensions will serve to separate *C. flemingi* from the only other unsculptured species of the Neocene of Virginia and North Carolina, the *Cæcum glabrum* of Montagu.

The species is named in honor of the author of the genus.

*Distribution.*—*Duplin Formation.* Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Waccamaw Formation.* Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Turritella duplinensis* new species. Plate II, fig. 4.

*General Characters.*—Shell a uniformly tapering pyramid, relatively more slender in the immature stages than in the adult. Volutions approximately 15 in number. Earlier coils prominently keeled at the periphery, the later trapezoidal, or slightly overhanging. Peripheral angle approaching a right angle. Base flattened to slightly convex in the adult. Suture lines distinct, the later whorls somewhat constricted.

*Protoconch.*—Protoconch small, smooth, twice-coiled, with slightly tilted tip.

*Sculpture.*—Axial sculpture absent or restricted to faint, irregular, incremental wrinkles on the later whorls of the adult. Spiral sculpture fairly constant for the genus; in a typical, half-grown individual, a single, well rounded primary, situated posterior to the suture line and strong enough to subcarinate the later whorls; secondaries 2 in number, as a rule, the one outlining the equatorial region of the whorl, the other a little behind it, the latter increasing in prominence away from the apex, the former crowning the periphery of the earlier whorls, decreasing in relative elevation anteriorly; a tertiary intercalated about midway between the suture and the posterior secondary, and another directly in front of the primary and constituting the circumbasal lira of the ultima; quaternaries sub-equal, and separated by equal interspaces, 12 to 15 in number, 3 between the posterior tertiary and the suture, 1 to 3 between the posterior tertiary and the posterior secondary, 3 or 4 between the two secondaries, 5 between the anterior secondary and the primary, 1 to 3 between the primary and the anterior tertiary and occasionally 1 or 2 between the anterior tertiary and the suture; basal liræ 15 to 20, the majority of them fine, but with coarser threads irregularly interspersed.

*Aperture.*—Aperture holostomous, sub-quadrate. Outer lip straight. Inner lip strongly arcuate.

*Dimensions.*—Altitude, 24.0 mm. Maximum diameter, 6.5 mm.

*Type Locality.*—Natural Well, Duplin County, North Carolina.  
*Duplin Formation.*

*Observations.*—*Turritella duplinensis* bears a strong resemblance to the laterally compressed race of *Turritella subannulata* Heilprin. It is doubtless closely related and may be a precursor. It also suggests *Turritella æquistriata* Conrad in general outline and type of sculpture, although the latter is keeled at the median line of the volution, the lirations are broader, more nearly equal in size, and separated by linear interspaces.

In the single adult form in the U. S. National Museum Collection from the Cape Fear River, the systems have broken down and the liræ are numerous, equisized, irregularly alternating, and tending to concentrate on the anterior portion of the whorl. This suggests the possible identity with *Turritella carolinensis*, vaguely described and badly figured by Conrad in 1875.\* It is probable, however, that the latter is characterized by a relatively broader base, and a consistently more uniform spiral sculpture. Conrad's type is not available, unfortunately, and it seems unwise to attempt to establish definite relationships between two species, one of which is so ill defined.

*Distribution.*—*Duplin Formation.* Natural Well, 1½ miles north of Magnolia, Duplin County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. Porter's Landing, Savannah River, Georgia. *Waccamaw Formation.* Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina.

*Turritella duplinensis* is the most abundant and characteristic species of the Formation from which it has received its name.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Liotia (Arenæ) major* new species. Plate IV, figs. 1, 3.

*General Characters.*—Shell nacreous within. Large for the genus. Scalar-turbinate in outline. Spire moderately elevated, scalariform. Body whorl well rounded, though pseudo-angulated by the prominence and position of the spirals. Whorls 6 in number,

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\*Conrad in Kerr, 1875, Rept. Geol. Survey, North Carolina, Appendix A, p. 22, pl. iv, fig. 8.

including those of the protoconch. Suture lines distinct but not impressed.

*Protoconch*.—Protoconch small and smooth, not sharply differentiated from the conch, twice-coiled. Initial turn quite highly inflated, immersed only at the tip. Succeeding volution increasing rapidly in diameter and gradually assuming the angular outline of the whorls of the conch. Opening of conch indicated by the appearance of a faint sculpture and by the sharpening of the shoulder angle.

*Sculpture*.—Axial sculpture absent excepting for incrementals; incrementals vigorous, oblique to the sutures, most conspicuous upon the shoulder at their intersection with the moniliform spirals and within the umbilicus. Spiral sculpture of coarse, heavily beaded liræ, 2 in number upon the earliest sculptured whorl, the one outlining the shoulder, the other midway between the shoulder and the anterior suture; a third lira which increases rapidly in prominence until near the aperture it almost, but not quite, equals those on either side, intercalated midway between them; a fourth non-annulate liration emergent from behind the posterior suture of the body whorl and outlining the anterior margin of the periphery. Base ornamented with 4 broad, flattened fillets, somewhat irregular in size and spacing, occasionally sulcated medially, and with a fortuitous secondary introduced behind the periphery. Umbilical carina very prominent, heavily annulated.

*Aperture*.—Aperture entire, sub-circular in outline. Outer lip heavier and more broadly arcuate than the inner margin, crenulated in harmony with the external sculpture. Pillar not reinforced. Parietal wall heavily glazed.

*Umbilicus*.—Umbilicus scalariform, profound, persistent to the apex of the spire, sculptured with indistinct spiral liræ and heavy incrementals.

*Dimensions*.—Altitude, 5.7 mm. Maximum diameter, 8.7 mm. Diameter at right angles to the maximum diameter, 7.5 mm.

*Type Locality*.—Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Duplin Formation*.

*Observations*.—*Liotia major* is much the largest of any of the Liotias recorded from the area under discussion, though not so large as *Liotia shackelfordensis* Olsson, the closely related Yorktown analogue. *L. major* differs from the common co-existent *L. gemma* in the development of strong basal spirals and in the



absence of a sutural channel and of any radial sculpture other than the incrementals. *L. shacklefordensis* is higher relatively and differs in the details of the body sculpture.

The shell is well protected by an outer percellanous covering, which, in the best preserved individuals, completely conceals the nacre within. The weathered shells are so highly iridescent, however, that they are much more suggestive of *Solariella* than of *Liotia*.

*Distribution.*—*Duplin Formation.* Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. Not uncommon.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Pandora (Clidophora) prodromos* new species. Plate IV, figs. 9, 11, 12, 14.

*General Characters.*—Shell of moderate dimensions, rather heavy, compressed. Inequivalve. Strongly inequilateral. Sub-quadrate in outline. Umbones very low and inconspicuous, often perforate, strongly anterior. Lunula not developed. Escutcheon persisting to the extremity of the posterior dorsal margin, sub-linear, sharply delimited. Anterior extremity broadly rounded. Posterior extremity quite squarely truncate. Dorsal margin feebly convex. Ventral margin broadly arcuate. Submarginal carina outlined in the right valve by a linear sulcus, in the left by a sub-acute ridge. Anterior area very obscurely differentiated, occupying approximately one-third of the entire valve.

*Sculpture.*—Radial sculpture not developed. Incremental sculpture somewhat undulatory on the early portion of the valve, laminar and crowded toward the ventral margin.

*Ligament.*—Ligament internal, lodged, in the right valve between the middle and posterior cardinals and, in the left valve, in a bilobed pit posteriorly produced along the dorsal margin.

*Dentition.*—Hinge dentition robust. Anterior cardinal of right valve almost entirely obsolete. Middle cardinal elongate, rhombic, strongly and abruptly elevated. Posterior cardinal compressed, elongate-cuneate, wedging out dorsally. Anterior cardinal of left valve extending from the apex of the umbones to the anterior adductor scar, uniformly elevated, widening slightly toward the umbones. Posterior cardinal linear, inconspicuous, outlining the anterior margin of the resilial pit.

*Muscle Impressions and Pallial Line.*—Adductor impressions small, slightly sunken, irregularly rotund, placed well up toward

the dorsal margin. Pallial line punctate, broadly arcuate, remote from the ventral margin.

*Dimensions*.—Altitude, 33.0 mm. Latitude, 21.0 mm. Diameter, 6.0 mm.

*Type Locality*.—Yorktown, York County, Virginia. *Yorktown Formation*.

*Observations*.—Though *Pandora prodromos* does not occur at Mayesville, the species has been described in this paper in order to bring out the close relationship which apparently exists between the Tertiary Pandoras of the East Coast and the Recent. In the Recent, the sub-genus *Clidiophora* is represented south of the Hatteras axis by the delicate, alate little form, *Pandora trilineata* Say. The northern analogue, *P. gouldiana* Dall, is larger, heavier, and rudely rectangular in outline. The differences between the northern and the southern analogues have apparently been inherited from their Tertiary precursors, *Pandora tuomeyi* new species of the Duplin and Waccamaw faunas and *Pandora prodromos* of the Yorktown. *P. prodromos* is a little higher, relatively than *P. gouldiana* Dall, and the posterior margin is not so sharply constricted below the sub-marginal keel. The dentition of the Tertiary species is very much heavier than that of the Recent. The middle and posterior cardinals of the right valve and the anterior cardinal of the left are, in *P. gouldiana* Dall, compressed into little more than linear ridges, while in *P. prodromos* they are decidedly heavy and robust. *P. prodromos* is neither so large nor so heavy, however, as the co-existent *P. crassidens* Conrad; there is no trace retained of the linear radial sculpture which characterizes *crassidens*, and the dorsal portion of the anterior cardinal of the left valve is not expanded into a well defined flange as in Conrad's species.

*Distribution*.—*Yorktown Formation*. Yorktown, York County; 1½ miles north of Suffolk, 1½ miles east of Suffolk, 1 mile northeast of Suffolk, 1 mile west of Suffolk, and ½ mile below the water works dam at Suffolk, Nansemond County, Virginia. Tar Ferry, on Wiccacon Creek opposite Harrelsville, Hertford County, North Carolina.

*Collections*.—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Pandora* (*Clidiophora*) *tuomeyi* new species. Plate IV, figs. 8, 10, 13.

*Pandora trilineata* Say, 1856, Tuomey and Holmes, *Pleiocene Fossils South Carolina*, p. 76, pl. xx, fig. 13.

Not *Pandora trilineata* Say, 1822, Jour. Acad. Nat. Sci. Philadelphia, 1st ser., vol. ii, p. 261.

*Pandora (Clidiophora) trilineata* Say, 1903, Dall, Trans. Wagner Free Inst. Sci. Philadelphia., vol. iii, pt. vi, p. 1519 (ex parte).

*General Characters.*—Shell rather small, rather thin. Transversely alate in outline, slightly flexuous, compressed. Inequi-valve, but only to slight degree. Strongly inequilateral. Umbones very low, the apices usually perforate, strongly anterior but not terminal. Lunule absent. Escutcheon sub-linear, almost as long as the posterior dorsal margin, strongly angulated upon its outer border. Anterior end of valve sharply rounded or obtusely pointed. Posterior dorsal margin gently convex. Submarginal carinæ very sharp, wider and more depressed posteriorly in the left valve than in the right. Ventral margin curving wing-like from the anterior expansion to the posterior rostrum. Margin in front of the rostrum contracted in the left valve by the antero-rostral depression. Right carina outlined by a linear sulcus. Anterior area between one-third and one-half the entire valve, differentiated only in the left valve, and then merely by a more or less obsolete, linear sulcus and the abrupt upcurving of the growth lines toward the front.

*Sculpture.*—Radial sculpture usually absent even in the right valve. Incremental sculpture fine, irregular, often discontinuous, with no very pronounced resting stages.

*Ligament.*—Ligament entirely internal; lodged in the right valve, between the middle and posterior cardinals and, in the left valve, in a bilobed pit, posteriorly produced beneath the dorsal margin.

*Dentition.*—Hinge dentition moderately robust. Anterior cardinal of right valve obsolete. Middle cardinal compressed, rhomboidal or hatchet-shaped. Posterior cardinal compressed, obliquely produced, often acutely pointed medially or ventrally. Anterior cardinal of left valve a moderately prominent ridge of uniform elevation extending from the umbones to a point just dorsal to the medial line of the anterior adductor. Posterior cardinal linear, inconspicuous, seated upon the anterior edge of the resilial pit.

*Muscle Impressions and Pallial Line.*—Adductor muscle impressions slightly sunken, irregularly rotund. Pallial line punctate, non-sinuous, nearer the base anteriorly than posteriorly.

*Dimensions.*—Altitude, 9.5 mm. Latitude, 21.0 mm. Semi-diameter (left valve), 2.0 mm.

*Type Locality.*—Walker's Bluff, Bladen County, North Carolina. *Waccamaw Formation.*

*Observations.*—*Pandora tuomeyi* has apparently been confused with the recent *Pandora trilineata* Say, a rather smaller, and relatively lower species, more tapering in outline posteriorly. The most fundamental difference lies, however, in the dentition. In general, the cardinals of the recent species are the more compressed, the more produced, and the more sharply cut. In particular, the inner surface of the right valve of the Tertiary form, in front of the middle cardinal, is not thickened, but often feebly channelled; the middle cardinal is hatchet-shaped or rhomboidal and shorter than the elevated laminar tooth of *P. trilineata*; the posterior cardinal is shorter, heavier, and less uniform in elevation, and the inequality between the two right cardinals is much more marked in the fossil than in the recent species. In the left valve, the resilial pit in *tuomeyi* is broader and less produced, and the cardinal upon its anterior margin, shorter and less sharp; the left cardinal in *P. trilineata* has strongly defined margins, bears a flange upon the dorsal half of its inner surface, and terminates ventrally near the dorsal end of the anterior adductor impression; the anterior cardinal of *tuomeyi*, on the other hand, suggests much more strongly a kinship to the sub-genus *Kennerleyia*; its anterior limit is often ill-defined, and the hiatus between such a tooth and the incurved and calloused surface of the anterior margins of *Kennerleyia* is not great; the cardinal in *tuomeyi*, furthermore, is not expanded dorsally into a flange, and is placed forward so that its ventral termination is at the medial line of the adductor impression.

The young of *Pandora carassidens* Conrad, while similar in dentition, are relatively higher, less alate, heavier, and less compact in shell texture, and show a very much stronger tendency toward radial sculpture in the right valve.

*Distribution.*—*Duplin Formation.* Darlington, Darlington County; Muldrow's Mills, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Waccamaw Formation.* Walker's Bluff, Cape Fear River, Bladen County, North Carolina.

*Collections.*—U. S. National Museum. Johns Hopkins University. Academy of Natural Sciences of Philadelphia.

*Strigilla outykta* new species. Plate III, figs. 4, 8, 10.

*General Characters.*—Shell sub-orbicular, slightly oblique, inequilateral, moderately inflated in the umbonal region. Anterior

end evenly rounded from umbone to base. Posterior end somewhat obliquely produced and obscurely truncate dorsally, rounded laterally. Base very gently curved. Umbones inconspicuous, opisthogyrate, placed a little in front of the median line. Lunule rather narrow, clearly delimited, Escutcheon narrow, somewhat elongated.

*Sculpture*.—External sculpture typical of the genus in general character. Posterior portion of the valve slightly depressed but not angulated, sharply differentiated, however, by the discrepant ornamentation. Medial and anterior positions covered with fine, chiselled grooves which extend from the boundary line of the posterior area and from the ventral margin obliquely upward and forward to the umbones and anterior margin. Grooves of posterior area arranged in crowded concentric chevrons with a high apical angle directed toward the umbones.

*Ligament*.—External characters as in *Strigilla flexuosa* Say. Ligament external, opisthodetic.

*Dentition*.—Right valve armed with a very small, simple, anterior cardinal, a much more prominent bifid posterior cardinal, and a strong, posterior and anterior lateral. Dentition of left valve reduced to a moderately stout anterior, and a very slender, laminar, posterior cardinal. Dorsal margins slightly modified to function as laterals.

*Muscle Impressions and Pallial Line*.—Muscle impressions indistinct. Anterior somewhat more elongated than the posterior. Pallial line rarely discernible, its dorsal margin a low arch extending from the ventral boundary of one adductor to the ventral boundary of the other, rising a little higher in the left valve than in the right, but not even in its maximum elevation overreaching the medial line of the adductors.

*Dimensions*.—Altitude of type, 10.7 mm. Latitude, 11.0 mm. Semi-diameter, 3.3 mm. Altitude of other figured individuals, 10.1 mm.; 8.7 mm. Latitude, 10.5 mm.; 9.3 mm. Semi-diameter, 2.8 mm.; 2.2 mm.

*Type Locality*.—Walker's Bluff, Cape Fear River, Bladen County, North Carolina. *Waccamaw Formation*.

*Observations*.—Representatives of this species have formerly been included under *Strigilla flexuosa* Say. Say's type is not available at present nor does he give a specific locality. From a comparison of his description and the recent material in the reference collections in the National Museum, it seems probable that the

type comes from off the eastern coast of Florida or from the Bahamas. These forms are more convex than *Strigilla eutykta*, more inequilateral, less rounded, and shorter anteriorly, and are sculptured posteriorly with a fine zigzag grooving instead of the elongated cone-in-cone of the new species. There is a considerable degree of variation among the recent forms, but the characters hold constant for any one general locality. In the shells from off the west coast of Florida the sculpture is approximately uniform over the entire valve. It is possible that even among the recent faunas, the species has not been sufficiently restricted. The species figured on Plate iv, fig. 9, is from Cape Florida, Catalogue Number 93380 of the U. S. National Museum Collection.

*Distribution.*—*St. Mary's Formation.* 2½ miles northwest of Williamston, Martin County, North Carolina. *Duplin Formation.* Natural Well, 1½ miles north of Magnolia, Duplin County; 4 miles north of Lumberton, 2 miles below Lumberton, 4 to 5 miles below Lumberton, Fairmont (Ashpole), 1½ miles northeast of Fairmont, Robeson County; Lake Waccamaw, Columbus County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Marks Head Marl.* Porter's Landing, Screven County, Georgia. *Waccamaw Formation.* 4 miles south of Elizabethtown on Hammond Creek, and at Walker's Bluff on the Cape Fear River, Bladen County; Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina. *Caloosahatchie Formation.* Caloosahatchie River and Shell Creek, Florida.

*Collections.*—U. S. National Museum. Johns Hopkins University. The Academy of Natural Sciences of Philadelphia.

***Donax cuneola*** new species. Plate III, figs. 1, 3.

*General Characters.*—Shell small, ventricose, inequilateral, cuneate. Umbones posterior, opisthogyrate, inflated and fairly conspicuous for the genus. Anterior margin obliquely truncated. Posterior margin rounded. Base line straight or very slightly contracted in front of the posterior keel which is clearly defined, as a rule, by an elevated ray. Anterior area often feebly differentiated by an ill-defined rostrum.

*Sculpture.*—Radial sculpture fine and faint, much more conspicuous in forms from which the periostracum has been eroded. Basal serration sharp.

*Ligament.*—Ligament short, external, opisthodontic.

*Dentition.*—Hinge heavy for the genus and astonishingly variable within the limits of the species. Anterior cardinal of the right valve laminar, almost or entirely obsolete, the posterior trigonal and very strong. Cardinals of the left valve equal size and fairly strong. Laterals heavy, two in number in each valve.

*Muscle Impressions and Pallial Line.*—Anterior muscle impression rather small, cuneate, rounded ventrally. Posterior muscle impression rotund. Pallial line and sinus often obscure, the sinus very broad and deep, partially confluent ventrally with the pallial line.

*Dimensions.*—Altitude, 6.4 mm. Latitude, 10.0 mm.

*Type Locality*—Neill's Eddy Landing, Columbus County, North Carolina. *Waccamaw Formation.*

*Observations*—The most closely allied species is *Donax emmonsii* Dall. From this form, *Donax cuneola* is separated by the higher, more tumid umbones, the more oblique anterior, the more rounded posterior and the straighter ventral margin, the faintly indicated anterior angulation, the more strongly differentiated posterior area, and the heavier, more compact hinge teeth. From *Donax fossor* Say, it is distinguished by the relatively greater altitude, the more nearly central umbones, and the less produced anterior margin.

*Distribution.*—*Yorktown Formation.* Yorktown, York County; 1½ miles northeast of Suffolk, Nansemond County, Virginia. *Duplin Formation.* 4 miles northeast of Fairmont, Robeson County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Waccamaw Formation.* Walker's Bluff, Cape Fear River, Bladen County; Neill's Eddy Landing, 3 miles north of Cronley, Cape Fear River, Columbus County, North Carolina.

*Collections.*—U. S. National Museum. Johns Hopkins University. The Academy of Natural Sciences of Philadelphia.

*Macoma carolinensis* new species.. Plate III, figs. 5, 6, 7.

*General Characters.*—Shell thin. Inflated. Irregularly ovate, with a very feeble posterior flexure. Slightly inequivalve, the right valve a little higher than the left. Inequilateral. Anterior dorsal slope gentle, merging gradually into the broadly rounded anterior end. Posterior end blunt. Anterior dorsal and ventral margins usually converging at a very low angle in the right valve, parallel in the left. Posterior dorsal margin declining much more

rapidly than the anterior. Ventral margin approximately straight medially, slightly upcurved distally. Umbones low, opisthogyrate, situated a little behind the median line.

*Sculpture*.—External surface smooth except for feeble incrementals. Faint traces of radial color markings also visible.

*Ligament*.—Ligament external, opisthodetic, seated on a narrow and elongated nymph.

*Dentition*.—Dentition as in *Macoma virginiana* Conrad. Anterior cardinal of the right valve simple and stout. Posterior bifid and relatively slender. In the left valve a bifid, relatively heavy anterior, and a simple, sub-laminar posterior cardinal.

*Muscle Impressions and Pallial Line*.—Interior faintly striated radially. Anterior muscle impression elongated. Posterior semi-elliptical. Pallial sinus deep, projected more than two-thirds of the distance forward toward the anterior margin, confluent ventrally with the pallial line for about one-half its length, its dorsal margin, in the right valve, bowed upward perceptibly beneath the umbones; in the left valve, apparently much more nearly parallel to the base.

*Dimensions*.—*Right valve*. Altitude, 12.3 mm. Latitude, 18.2 mm. Semi-diameter, 4.3 mm. *Left valve*, of another individual. Altitude, 12.5 mm. Latitude, 19.5 mm. Semi-diameter, 3.3 mm.

*Type Locality*.—Darlington, South Carolina. *Duplin Formation*.

*Observations*.—*Macoma carolinensis* is the analogue in the Neogene south of the Hatteras axis of *Macoma virginiana* and its subspecies *conradi* north of the axis. It is rather higher, less flexuous, and more nearly equilateral than either of the former, both by reason of the more nearly central umbones and the greater similarity of the anterior and posterior extremities. The posterior dorsal margin of *M. carolinensis* has a uniform, fairly steep slope, while that of *M. virginiana* is slightly contracted directly behind the umbones, then obliquely produced at a very low angle. The posterior lateral margin of the former is rounded into the slightly upturned base, that of the latter, obscurely truncated and its ventral margin more strongly recurved. The pallial sinus in both species varies quite widely but that of *carolinensis* is, on the average, more profound, and more strongly arched beneath the umbones.

The species is rare in the *Duplin* and *Waccamaw* Formations of North and South Carolina.



*Distribution.*—*Duplin Formation.* 2 miles below Lumberton, Robeson County, North Carolina. Darlington, Darlington County; Muldrow's Place, 5 miles south east of Mayesville, Sumter County, South Carolina. *Waccamaw Formation.* Mrs. Guion's marl pit, Cape Fear River, Columbus County, North Carolina.

*Collections.*—U. S. National Museum. Johns Hopkins University. The Academy of Natural Sciences of Philadelphia.

*Mulinia magnoliana* Dall. Plate III, fig. 2.

*Spisula (Hemimactra ?) magnoliana* Dall, 1898, Trans. Wagner Free Inst. Sci. Philadelphia, vol. iii, pt. iv, p. 899, pl. xxvii, fig. 29.

*Original Description.*—"Shell small, equilateral, somewhat compressed, with small, little-elevated, pointed, adjacent beaks; surface smooth except for lines of growth and a feeble angulation extending backward from the umbo to the lower posterior margin; ends nearly equally rounded, the posterior slightly more pointed, the base moderately and evenly curved; pallial sinus small, angular, very short; hinge normal, feeble, with short, granulose laterals. Lon. 17, alt. 11, diam. 7 mm." Dall, 1898.

*Type Locality.*—Magnolia, Duplin County, North Carolina. *Duplin Formation.*

*Observations.*—In the unique valve, which was selected as the type of *Spisula magnoliana* Dall, the cardinal margin has been broken away, and the edges so perfectly rounded by erosion, that all traces of the characteristic ligamentary attachment of the *Mulinia* have been obliterated and replaced by a pseudospisuloid attachment. This fact was established by the examination of fresh individuals in which the septum had been recently chipped away.

The subspecies is separated from the closely related protean *congesta* by the lower, more regularly oval and elongate valves, the less prominent umbones and the short, rather heavy laterals.

*Distribution.*—*St. Mary's Formation.* South Quay, Nansemond County, Virginia. 3½ miles below Palmyra Bluff, Halifax County; 8 to 9 miles south of Greenville, Pitt County; 1 mile north of Castoria, Greene County, North Carolina. *Yorktown Formation.* Rock Landing, Craven County, North Carolina. *Duplin Formation.* 10 miles south of Clinton, Sampson County, Natural Well, ½ mile north of Magnolia, Duplin County; 2 miles below Lumberton, Robeson County, North Carolina. Muldrow's Place, 5 miles southeast of Mayesville, Sumter County, South Carolina. *Brun-*

wick River bed, Brunswick, Glynn County, Georgia. *Waccamaw Formation*. Walker's Bluff, Bladen County, Neill's Eddy Landing, 3 miles north of Cronley, Columbus County, North Carolina.

*Collections*.—U. S. National Museum (type, Catalogue Number 115080). Johns Hopkins University.

#### EXPLANATION OF PLATES I, II, III AND IV.

PLATE I.—Fig. 1.—*Drillia precursor* n. sp. (×8)

Fig. 2.—*Drillia tricalenaria* Conrad. (×4)

Fig. 3.—*Drillia sumterensis* n. sp. (×4)

Fig. 4.—*Mitra dalli* n. sp. (×8)

Fig. 5.—*Alectrion neogenensis* n. sp. (×5)

Fig. 6.—*Alectrion neogenensis* (×5)

Fig. 7.—*Mitromorpha mitrodila* n. sp. (×7)

Fig. 8.—*Mitra dalli* n. sp. (×7)

Fig. 9.—*Cancellaria tabulata* n. sp. (×2)

Fig. 10.—*Phos sloani* n. sp. (×3)

PLATE II.—Fig. 1.—*Melanella bartschi* n. sp. (×3)

Fig. 2.—*Anachis sumterensis* n. sp. Apical view. (×10)

Fig. 3.—*Anachis anomala* n. sp. (×6)

Fig. 4.—*Turritella duplinensis* n. sp. (×2)

Fig. 5.—*Strombiformis dalli* n. sp. (×6)

Fig. 6.—*Anachis sumterensis* n. sp. (×8)

Fig. 7.—*Anachis styliola* n. subsp. *obsoleta*. Type. (×4)

Fig. 8.—*Melanella magnoliana* n. sp. (×8)

Fig. 9.—*Anachis styliola* n. subsp. *obsoleta*. Stout form. (×4)

Fig. 10.—*Epitonium muldrowi* n. sp. (×8)

Fig. 11.—*Astyris communis* n. subsp. *carolinensis*. (×3)

Fig. 12.—*Anachis styliola* n. subsp. *obsoleta*. Stout form. (×4)

PLATE III.—Fig. 1.—*Donax cuneola* n. sp. Exterior of right valve. (×3)

Fig. 2.—*Mulinia magnoliana* Dall. Interior of left valve. After Dall. (×2.5)

Fig. 3.—*Donax cuneola* n. sp. Interior of right valve. (×3)

Fig. 4.—*Strigilla eutykta* n. sp. Exterior of right valve of type. (×4)

Fig. 5.—*Macoma carolinensis* n. sp. Exterior of right valve of type. (×3)

Fig. 6.—*Macoma carolinensis* n. sp. Interior of right valve of type. (×3)

Fig. 7.—*Macoma carolinensis* n. sp. Interior of left valve. (×3)

Fig. 8.—*Strigilla eutykta* n. sp. Interior of left valve. (×4)

Fig. 9.—*Strigilla flexuosa* Say. Exterior of left valve. (×4)

Fig. 10.—*Strigilla eutykta* n. sp. Interior of right valve. (×4)

PLATE IV.—Fig. 1.—*Liotia (Arene) major* n. sp. Profile. (×4)

Fig. 2.—*Urosalpinx phriknos* n. sp. Apical view. (×6)

Fig. 3.—*Liotia (Arene) major* n. sp. Basal view. (×4)

Fig. 4.—*Urosalpinx phriknos* n. sp. (×2)

Fig. 5.—*Caecum flemingi* n. sp. (×6)

Fig. 6.—*Urosalpinx phriknos* n. sp. Profile of apex. (×6)

Fig. 7.—*Urosalpinx phriknos*. Apertural view. (×2)

Fig. 8.—*Pandora (Clidiophora) tuomeyi* n. sp. Interior of right valve. (×2)

Fig. 9.—*Pandora (Clidiophora) prodromos* n. sp. Exterior of right valve. (×1)

Fig. 10.—*Pandora (Clidiophora) tuomeyi* n. sp. Exterior of left valve. (×2)

Fig. 11.—*Pandora (Clidiophora) prodromos* n. sp. Exterior of left valve. (×1)

Fig. 12.—*Pandora (Clidiophora) prodromos* n. sp. Interior of right valve. (×1)

Fig. 13.—*Pandora (Clidiophora) tuomeyi* n. sp. Interior of left valve. (×2)

Fig. 14.—*Pandora (Clidiophora) prodromos* n. sp. Interior of left valve. (×1)

## March 18.

The President, JOHN CADWALADER, A.M., LL.D., in the Chair.

Thirty-six persons present.

A paper entitled "A Study of the Orthopterous Genus *Mercuria Stål*", by JAMES A. G. REHN, was presented for publication.

The deaths of the following members were announced:

Charles J. Bender.

Francis A. Cunningham.

The death of Raphael Blanchard, a correspondent, was also reported.

*Oyster Farms of Delaware Bay.*—DR. PILSBRY spoke of the oyster industry of Delaware Bay, illustrating his remarks with photographs taken mainly on Maurice River, New Jersey. The processes of oyster cultivation were described. In Maurice River Cove the beds are seeded from oysters dredged in deeper parts of the Bay, but probably reproduction on the spot is the chief source of the supply. On mud bottom a cultch of oyster shells is first scattered. This is not necessary on sand or gravel bottom. The situation of these beds, remote from any source of sewage, insures a wholesome food supply, free of pathologic bacteria. The processes and apparatus of dredging, freshening ("drinking"), and culling were shown by lantern illustrations. In the autumn months the oysters cannot remain in the floats, in which they absorb fresh water, more than 24 hours. At the time of the speaker's visit (January), about 400 schooners were in commission.

The subject was further discussed by the President, who had long been interested in the development of this industry, and by Dr. Henry Skinner.

The following was ordered to be printed.

**A STUDY OF THE ORTHOPTEROUS GENUS *MERMIRIA* STÅL**

BY JAMES A. G. REHN

For a number of years we have found that any attempt to make determinations in this genus from the basis of the last revisionary treatise published upon it, that by Scudder in 1899, led us into difficulties, some clearly evident, others more subtle and then not possible of correction. In order to clear up the situation, Mr. Morgan Hebard and the author, in the course of extensive field work on the North American Orthoptera, have paid particular attention to this genus, as a result of which a most extensive series has been made accessible for study.

Within the last five years or so we have received an added incentive for making a comprehensive taxonomic, variational and distributional study of the genus *Mermiria*, in that we have had the pleasure and profit of association with Dr. C. E. McClung, who has made extensive studies on the chromosomes in this genus. From his work he was able to point out certain evident differentiations, which our studies show to be reflected in the external morphological features, and it was his earnest desire that a good taxonomic groundwork be laid for future work, cytological as well as morphological.

The author owes much to the encouragement and assistance of Dr. McClung in the preparation of this paper, the assistance being of a practical character, as the basic sorting of the whole series studied was made by him in intervals between his official duties, and the first draft of a key to the species was also drawn by him. The cordial coöperation and valued suggestions given by him have made easier some of the irksome portions of the examination and analysis of the really large series on which this paper is based. We are also indebted to our colleague, Mr. Hebard, for numerous suggestions and kindly criticisms, as well as unrestricted use of his collection.

***MERMIRIA* Stål**1839. *Opsomala* Serville, Hist. Nat. Ins., Orth., p. 586. (Part.)1870. *Opomala* Thomas, Proc. Acad. Nat. Sci. Phila., 1870, p. 77. (Error for *Opsomala*.)

1873. *Mermiria* Stål, Recensio Orthopt., i, p. 102. [*M. belfragii* Stål.]  
 1877. *Mermiria* Scudder, Proc. Boston Soc. Nat. Hist., xix, p. 30.  
 1890. *Mermiria* Bruner, Proc. U. S. Nat. Mus., xii, p. 53.  
 1897. *Mermiria* McNeill, Proc. Davenp. Acad. Nat. Sci., vi, pp. 195, 203.  
 1899. *Mermiria* Scudder, Proc. Amer. Acad. Arts and Sci., xxxv, p. 41.  
 1904. *Mermiria* Bruner, Biol. Cent.-Amer., Orth., ii, pp. 26, 37.  
 1904. *Papagoa* Bruner, Ibid., ii, pp. 27, 42. [*P. arizonensis* Bruner.]

Genotype: *M. belfragii* Stål (= *Opomala neo-mexicana* Thomas).

Type by monotypy.

*Position of Genus.*—The genus *Mermiria* is the sole member of the group Mermiriæ. The other genus placed in that group by Bruner, 1893, was *Syrbula*, and this has no close affinity with *Mermiria*, being instead a member of the group Amblytropidiæ.<sup>1</sup> No affinity exists with any of the typical Hyalopterygine genera, such as *Hyalopteryx*, *Achurum*, *Eutruxalis*, *Truxalis* and *Radinotatum*, but considerable resemblance and some real relationship is evident with *Pseudopomala*, which is an aberrant Hyalopterygid, probably connecting the latter group with the Mermiriæ. The genus *Acantherus* is not allied and its affinities are clearly with the Orphulellæ or the Amblytropidiæ, or perhaps both.

The exact position of the Mermiriæ in the sub-family Acridinæ remains to be determined, and then only after a comprehensive study of the known genera, but it is evident that its development was probably from a Hyalopterygine stock, possibly through *Pseudopomala*, and the Mermiriæ should, at least, be kept in the general neighborhood of the Hyalopteryges.

*Generic Description.*—Form typically Truxaloid, elongate, alate. Head with facial line decidedly retreating: fastigio-facial angle evident: fastigium produced, angulate to rounded, weakly or not at all carinate, weakly or moderately impressed: lateral foveolæ obsoletely to appreciably indicated, sub-ventral in position, not visible from the dorsum: frontal costa sharply indicated, continuous, in part at least sulcate: lateral facial carinæ prominent, diverging ventrad: eyes ovoid to ovoid-elliptical, axis dorso-cephalad to ventro-caudad, moderately prominent from dorsum: antennæ ensiform, deplanate. Pronotum longitudinal, median carina indicated, with or without lateral carinæ: lateral lobes normal, with or without supplementary longitudinal carinæ at middle, ventral margin of lateral lobes distinctly or scarcely thickened: caudal margin of disk arcuate or angulate; prozona of dorsum

<sup>1</sup> This is very evident after making comparisons of *Syrbula* with a number of genera of the Amblytropidiæ. It is clearly not far removed from *Leurocerus* and *Amblytropidia*.

always longer than metazona. Tegmina and wings fully developed. Prosternum with low median protuberance or slight transverse ridge: mesosternal lobes separated by a distinct interspace or subattingent: metasternal lobes separated by a narrow interspace to attingent. Subgenital plate of ♂ very bluntly, moderately or strongly conoid produced, hardly compressed. Cephalic and median limbs short, slender. Caudal femora moderately robust to slender, genicular lobes and angles not produced; caudal tibiae with spines of external margin more numerous than those of internal margin.<sup>2</sup>

*Classification.*—The features of greatest value in differentiating the species of the genus are almost entirely structural, although several color features are of relative, or even, in one case in one sex, of primary importance. The most important feature, and one which shows no intra-specific variation in this genus, is the presence or absence, and strength when present, of lateral pronotal carinae. In all but *intertexta* there can be no question of the presence or absence of these structures, while in *intertexta* they are weakly indicated. In certain species there is found, bordering ventrad the paired dark lateral bars on the postocular region of the head and the lateral lobes of the pronotum, a strumose line or carina. This is distinctly indicated in *texana* and *alacris*, and incompletely and weakly so in *neo-mexicana* and *intertexta*. The lateral foveolae of the vertex are of taxonomic importance in the depth of their indication, but there is some variation in this feature. The general form of the fastigium, of the fastigio-facial angle and the angle of the facial line are of value, but there is much variation in the exact degree of these features, particularly in that of the form of the fastigium. The proportion of length to depth of the lateral lobes of the pronotum is a feature which has considerable importance. The very slender or the average form of the caudal femora are also features of value, but there is much individual variation in that considered average, although the very slender type is more constant. The antennae show certain specific types which, however, are very difficult to compare satisfactorily. The general form, whether average or very slender, is also an important feature in this genus. We find so little wing length variation that the relative form remains approximately uniform within each species.

<sup>2</sup> These are so variable in number (at least 15 to 24 on external, and 14 to 20 on internal margin) that they cannot be used as diagnostic features for the genus.

The diagnostic features given by Scudder in the key of his study of the genus are largely valueless, extensive series exhibiting clearly their variability. In a few cases their importance is relative, but not primary.

*Morphological Variational Notes.*—Probably the most striking feature of variation in the external morphology of the species of this genus is in the form of the fastigium, when viewed from the dorsum. Practically the only satisfactory method of comparison in the variation of this feature is to measure the angle, and the extremes have been figured and discussed under each species. The folly of using a feature of this sort in a strictly diagnostic sense is evident when it is known that certain species show variations of from 33° to 65° (*alacris*), 52° to 84° (*intertexta*), and 62° to 87° (*maculipennis maculipennis* and *mac. macclungi*) in the male sex, and 42° to 70°, 80° to 95°, and 65° to 95° respectively in the female sex. In addition to the exact angle there is much variation in the curvature or relative straightness of the margins themselves. The facial line shows occasional variation from the specific type, but these are generally geographic. The frontal costa varies much in its degree of sulcation and also in exact form, so much so that we prefer to dispense with it as a diagnostic feature. The form of the frontal costa, its exact width and relative depth are so variable that no great weight can be attached to these features. As we have already mentioned under "Classification," there is a very considerable amount of variation in the form of the caudal femora. Those species having the more slender type of caudal femora show less of such variation than the species having normally more robust and less attenuate femora.

There is a considerable amount of geographic variation in proportions and form, this being particularly apparent in southern Arizona material of *maculipennis* and *neo-mexicana*. In size, in addition, there is a very decided amount of geographic variation, the details of which are given under the individual species.

*Color Pattern.*—The basic color pattern of the genus is found in all the species, i. e. a pale base color, of a green, greenish-yellow, brownish or ochraceous tone, with a pair of dark postocular bars extending across the postocular portion of the head, the dorsal section of the lateral lobes of the pronotum, thence spreading out and to a greater or lesser degree continued as a narrow line on the pleura, and intensively coloring the marginal and discoidal fields of the tegmina. In addition there is frequently a medio-

longitudinal dorsal dark bar of variable strength and completeness, this always indicated in *texana* and carried over the anal field of the tegmina, leaving the anal angle pale. This medio-longitudinal line may be merely a lining of the median carina of the pronotum, or a pair of arcuate lines on the head. The tegmina in certain species (i. e., *bivittata* and both races of *maculipennis*) may show a maculate pattern of variable intensity. In all the species except *M. bivittata* the tegmina show a decided pale subcostal line on the proximal half in both sexes, while in *bivittata* the male sex is without such a line, although the female is marked as in the other species. In *M. neo-mexicana* and *alacris* the pale subcostal line broadens out into a wash which colors a very considerable portion of the tegmina, but its correlation with the subcostal line is evident. Occasionally the pale subcostal line is weak, but we have never seen it absent in any individuals but males of *bivittata*. The dark postocular lateral bars on the pronotum encroach upon the dorsal surface of the pronotum in numerous individuals of *maculipennis*, and in *texana*, *neo-mexicana* and *alacris* the dark postocular bars are bordered with yellowish. The lateral facial carinæ are similarly marked in the same species, and the face is variably infuscate in *texana*, *neo-mexicana*, *alacris* and *intertexta*.

*Groups*.—The genus comprises three groups, which at first glance appear more different than a detailed analysis indicates. One of these contains *texana* alone, another is made up of *neo-mexicana* and *alacris*, with *intertexta* an aberrant member approaching the third group, which is composed of *bivittata* and *maculipennis*. If the features separating these groups were more decided, or their differentiation more clearly indicated, it would be advisable to use subgeneric names for them, but this is not desirable, owing to the relatively slight divergence of the species, judging from external morphological features.

The groups and their chief features are:

Group A (*texana*)

Form relatively robust. Lateral foveolæ obsolete. Antennæ moderately heavy. Pronotum short. Lateral carinæ of pronotum distinct, diverging caudad. Supplementary carinæ on lateral lobes of pronotum distinct. Caudal limbs relatively robust. (Coloration distinctive.)



- Group B { *neo-mexicana*  
*alacris*  
*intertexta* } Form slender, elongate. Lateral foveolæ weakly indicated. Antennæ very heavy. Pronotum elongate. Lateral carinæ of pronotum distinct or incompletely indicated (*intertexta*), faintly if at all divergent caudad. Supplementary carinæ on lateral lobes of pronotum distinctly (*alacris*) or weakly (*neo-mexicana* and *intertexta*) indicated. Caudal limbs elongate, slender.
- Group C { *bivittata*  
*maculipennis* } Form less slender than in Group B, more attenuate than in Group A. Lateral foveolæ indicated to a greater (*maculipennis*) or lesser (*bivittata*) degree of completeness. Antennæ heavy. Pronotum short. No lateral carinæ on pronotum. No supplementary carinæ on lateral lobes of pronotum. Caudal limbs relatively robust.

We feel quite confident that Groups A and B are the more primitive ones, but which of these two is closer to the ancestral type is difficult to say. In some ways *texana* appears the more generalized, in others *alacris* and *neo-mexicana*, with *intertexta* clearly a more advanced type. We feel, however, that, as *texana* represents a divergence from the type species (*neo-mexicana*) in antithetical characters from Group C, a clearer presentation of the interspecific relationship is shown by arranging the species as done herein.

*Distribution of the Genus.*—From southern New Jersey (*intertexta*), central Illinois (*neo-mexicana* and *maculipennis macclungi*), Iowa (*neo-mexicana*, *bivittata* and *maculipennis macclungi*), Missouri River region of North Dakota (*neo-mexicana*), and eastern Montana (Forsyth—*maculipennis macclungi*); south to the Florida Keys (*intertexta*), the Gulf Coast (*bivittata*, *alacris* and *maculipennis maculipennis*), southern Texas (Mission and Lyford—*maculipennis maculipennis*), central Coahuila [Monclova] and northern Durango [Lerdo], Mexico (*texana*), and southern Arizona (Huachuca and Baboquivari Mountains—*texana*, *neo-mexicana* and *maculipennis maculipennis*); from the eastern coast of the United States west to northern Utah (Salt Lake City—*maculipennis macclungi*), southern Nevada (Rioville—*maculipennis maculipennis*), and central

southern Arizona (Baboquivari Mountains—*neo-mexicana* and *maculipennis maculipennis*). The genus is apparently absent, within this area, from the east central states, excepting certain portions of Illinois, and in the eastern states it has a very limited range, being absent from almost the entire Piedmont and more elevated regions, only a few records from above the fall-line in North Carolina, Georgia and Alabama being known. As one passes northward along the eastern coast the area of distribution narrows, until, in Virginia, it is merely the narrow coastal and estuarine marginal region. Beyond question a number of the species of the genus range over much of northern Mexico, but the lack of data from that region is so great that we can do no more than mention the probability of their occurrence.

All of the species are partial to grassland, tall salt marsh grass, grassy fresh marsh, prairie grassland, grass patches in park-like woodland, the clump type of bunch grass in arid steppe and sand-hill regions and even grassy pockets on steep rocky slopes. While frequently taken on other vegetation, the presence of grass will be found to be the influencing factor, and the campestrian environment is the favorite situation.

Zonally the genus *Mermiria* is an inhabitant of the Lower Austral, Sabalian and Tropical Florida Zones in the eastern states, narrowly encroaching on the Upper Austral in the northeast, while in the western and central United States it occurs in the Upper and Lower Austral Zones, entering areas of the lower part of the Transition Zone in western Texas (Davis Mountains) and southern Arizona (Santa Catalina Mountains) and possibly in the northwestern United States (Montana and North Dakota).

When tested out for a probable center of distribution we find that far the greater proportion of the factors, to be considered in locating such a center, give central Texas as the center of the generic dissemination and differentiation. This is the region of greatest differentiation, dominance in individuals, location of synthetic forms (i. e., *bivittata* and *maculipennis*, *neo-mexicana* and *alacris*), maximum size of individuals, convergence of lines of dispersal and of least dependence on a restricted habitat.<sup>3</sup>

<sup>3</sup> Our quotation of these criteria should not be taken as an indication that we are convinced of the propriety of using all of them for such work. We are following the general practice in so using them, but at least one, i. e. area of maximum size of individuals, can hardly be given equal importance with the others. The advent of species of insects into a favorable habitat, removed from their normal natural enemy control, often produces colonies of maximum sized individuals.

*History.*—The first species known belonging to the present genus was described by Serville, in 1839, as *Opsomala bivittata*.<sup>4</sup> The locality given was "North America," and the specimen described was from the Latreille Collection. The identity of this insect has been the disturbing factor in all subsequent work in the genus, but we have sufficient knowledge now to show that Latreille received material from Palisot de Beauvois and Bosc, and that the exact locality was probably in the Carolinas. In consequence we feel fully satisfied with our placing of Serville's name. In 1870, Thomas described another species as *Opomala* [sic] *neo-mexicana*, from northeastern New Mexico,<sup>5</sup> while in 1873 Stål erected the genus *Mermiria* for his new species *M. belfragii*, described from Texas,<sup>6</sup> which is identical with *neo-mexicana*. In 1877, Scudder described a third species from Georgia, under the name *Mermiria alacris*;<sup>7</sup> while, in 1890, Bruner described the striking *M. texana* from El Paso, Texas, and Lerdo, Durango, Mexico,<sup>8</sup> and also *M. maculipennis* from San Antonio and Carrizo Springs, Texas.<sup>9</sup> McNeill, in 1897, in his Revision of the Truxalinae, published the first study of the genus, and there described *M. rostrata*, from Mackay, Indian Territory.<sup>10</sup> The latter, we are now able to say, is but an extreme condition of *alacris*. McNeill made the error of referring material representing three different species to *bivittata*, and his study left us with no better conception of the group than we had before its publication. In 1899, Scudder published a short review of the species of the genus,<sup>11</sup> separating the eastern hygrophilous species as *M. intertexta*, and also describing *M. vigilans*, which latter has given authors considerable trouble since then, but which we now know to be an individual condition of *M. alacris*. Scudder united *maculipennis* with *bivittata*, "as at most only a variety." In 1904, in the *Biologia Centrali-Americana*, Bruner retained for the species of the genus the nomenclature used by Scudder in 1899.<sup>12</sup> In the same work he also erected<sup>13</sup> a new genus and species, *Papagoa arizonensis*,

<sup>4</sup> Hist. Nat. Ins., Orth., p. 589, (1839).

<sup>5</sup> Proc. Acad. Nat. Sci. Phila., 1870, p. 77, (1870).

<sup>6</sup> Recens. Orthopt., i, p. 102, (1873).

<sup>7</sup> Proc. Boston Soc. Nat. Hist., xix, p. 30, (1877).

<sup>8</sup> Proc. U. S. Nat. Mus., xii, p. 53, pl. I, fig. 11, (1890).

<sup>9</sup> Ibid., p. 54, (1890).

<sup>10</sup> Proc. Davenport Acad. Nat. Sci., vi, pp. 205, 207, pl. I, fig. 3c, (1897).

<sup>11</sup> Proc. Amer. Acad. Arts and Sci., xxxv, pp. 41 to 44, (1899).

<sup>12</sup> Biol. Cent.-Amer., Orth., ii, pp. 38 to 39, (1904).

<sup>13</sup> Ibid., pp. 27, 42, (1904).

for a specimen from "Arizona or Northern Mexico," which we now know to be a shrivelled alcoholic individual of *Mermiria texana*.

*Material*.—In the preparation of the present paper the types of the following species have been examined by us:

*Mermiria texana* Bruner.

*Papagoa arizonensis* Bruner (synonym of *M. texana*).

*Opomala neo-mexicana* Thomas.

*Mermiria alacris* Scudder.

*Mermiria vigilans* Scudder (synonym of *M. alacris*).

*Mermiria intertexta* Scudder.

*Mermiria maculipennis* Bruner.

*Mermiria maculipennis macclungi* new subspecies.

The entire series of the genus examined by us and here recorded numbers 1514 specimens. The majority (938) of these were taken by Rehn and Hebard on recent trips and are located in the Hebard Collection and that of the Academy of Natural Sciences of Philadelphia. Of the remainder of the representation we have had before us, 50 specimens were from the Hebard Collection ex Bruner, 33 specimens from the Scudder Collection at the Museum of Comparative Zoology at Cambridge, Massachusetts, 73 specimens from the United States National Museum, 39 specimens from the collection of Prof. A. P. Morse, 12 from that of Prof. M. P. Somes, 3 from the Illinois State Laboratory of Natural History, 103 from the Academy of Natural Sciences of Philadelphia (other than Rehn and Hebard collecting), and 263 specimens from other collections and institutions, including the Hebard Collection other than Rehn and Hebard collecting and ex Bruner. In addition to this material we have re-examined considerable material already recorded by Rehn and Hebard, and not included in these totals. All the institutions and collections represented in the studied series are indicated by their initials in the summaries of material under the species, with the exception of the series collected by Rehn and Hebard, which it should be understood, are in the Hebard Collection and that of the Academy of Natural Sciences of Philadelphia.

We wish to express our hearty thanks to the above mentioned gentlemen, and the authorities of these museums for their assistance in the present study. We have been able, with their assistance, to gather together a sufficiently extensive and representative series of the genus to give authority and permanency to the conclusions here reached.

*Key to Species.*

We would suggest that, in using this key, frequent reference be made to the figures accompanying the paper. Occasionally insistence is made upon a single differential character, and in such cases it should be borne in mind that these characters are the crucial ones, not subject to fluctuation by variation. Other features may aid in distinguishing the forms, and these are detailed under the specific treatments, but variation will occasionally rob these features of their critical value.

- A. Lateral carinæ of pronotum strongly or weakly (*intertexta*), but always appreciably indicated. Form slender or relatively robust; when of the latter type the tegmina bear a longitudinal pale line in distal half of discoidal field, in addition to the strongly marked proximal subcostal line and pale anal angles of tegmina.
- B. Supplementary carinæ on lateral lobes of pronotum evident (rather weakly in *neo-mexicana*). Species decidedly or typically xerophilous.
- C. Form relatively robust. Lateral carinæ of pronotum decidedly diverging caudad, rarely by variation subparallel. Lateral lobes of pronotum with ventral margin shorter than depth of lobes. Tegmina relatively broad. Color pattern bold, distinctive; subcostal pale line of tegmina strongly marked, narrow; medio-longitudinal dorsal line invariably present. Antennæ moderately ensiform. Caudal femora relatively robust, almost invariably falling distinctly short of the tegminal apices. Subgenital plate of male short, weakly produced, blunted.  
*texana* Bruner
- CC. Form slender. Lateral carinæ of pronotum not at all, or, by variation, faintly diverging caudad. Lateral lobes of pronotum with ventral margin longer than depth of lobes. Tegmina relatively narrow. Color pattern with broad medio-longitudinal dorsal line rarely present. Antennæ strongly ensiform. Caudal femora slender (surpassing, equalling, or falling faintly short of tegminal apices). Subgenital plate of male produced, elongate pyramidal.
- D. Fastigium more semi-elliptical, the sides converging in a well-rounded curve, the tip very broadly or at least bluntly rounded. Subgenital plate of male moderately produced. Species *campestris*, central and western in habitat..... *neo-mexicana* (Thomas)
- DD. Fastigium triangular, the sides converging in straight or only slightly curved lines, the tip narrowly rounded. Subgenital plate of male greatly produced. Species

- inhabiting grassy woodland, central and southeastern in habitat.....*alacris* Scudder
- BB. No supplementary carinæ on lateral lobes of pronotum. Species invariably hygrophilous. (Form very elongate. Ventral margin of lateral lobes of pronotum longer than depth of lobes. Subgenital plate of male greatly produced. Eastern and southeastern coast.) *intertexta* Scudder
- AA. No lateral carinæ indicated on pronotum. Form relatively robust; tegmina but faintly or not at all surpassing the apices of the caudal femora.
- B. Male with no subcostal pale bar on the proximal half of the tegmina. Fastigio-facial angle, when seen from the side, more broadly rounded in both sexes.<sup>14</sup> Coloration more frequently greenish. Species central and southeastern in habitat.....*bivittata* (Serville)
- BB. Male with subcostal pale bar on the proximal half of tegmina. Fastigio-facial angle, when seen from the side, more narrowly rounded and more angulate in both sexes.<sup>14</sup> Coloration more frequently buffy. Species central and western in habitat.
- C. Form more attenuate and elongate. Pronotum distinctly more elongate and appreciably constricted mesad; caudal angle of disk of pronotum very broadly and weakly angulate. Eyes of female moderately prominent, when viewed from the dorsum. Size in general larger. South-central and southwestern in habitat.  
*maculipennis maculipennis* Bruner
- CC. Form less attenuate and elongate. Pronotum shorter and relatively broader, not appreciably constricted mesad; caudal angle of disk of pronotum more distinctly produced and angulate. Eyes of female less prominent, when viewed from the dorsum. Size in general smaller. North-central in habitat.  
*maculipennis macclungi* new subspecies

### Treatment of Species

#### **Mermiria tezana** Bruner. Plate V, figs. 1-14.

1890. *Mermiria tezana* Bruner, Proc. U. S. Nat. Mus., xii, p. 53, pl. I, fig. 11. [♂ ♀: El Paso, Texas; Lerdo, Durango, Mexico.]
1897. *Mermiria tezana* McNeill, Proc. Davenp. Acad. Nat. Sci., vi, pp. 204, 206. [Lerdo (error for Lerdo), Durango, Mexico; El Paso, Texas; Colorado Springs, Colorado; Fort Grant, Arizona.]
1899. *Mermiria tezana* Scudder, Proc. Amer. Acad. Arts and Sci., xxxv, pp. 41, 42. [Colorado; Coahuila, Mexico; also summary of previously reported localities.]
1902. *Mermiria tezana* mut. *viridis* Cockerell, in Scudder and Cockerell, Proc. Davenp. Acad. Sci., ix, p. 24. [Las Vegas Hot Springs, New Mexico.]
1904. *Mermiria tezana* Bruner, Biol. Cent.-Amer., Orth., ii, p. 38, pl. I, figs. 19, 19a. [Summary of previous records.]
1904. *Papagoa arizonensis* Bruner, Ibid., p. 42. [♂: Arizona or northern Mexico.]

<sup>14</sup> These features are relative and average, and by variation overlapping.

The present species stands in a relatively isolated position in the genus, and it has been suggested to the author that it should be subgenerically differentiated from the genotype. We do not feel warranted in taking such action at this time, as we lack sufficient evidence to justify it. However, *texana* can be readily distinguished from all the other forms of the genus by combining with lateral pronotal carinæ and supplementary carinæ on the lateral lobes of the pronotum, a relatively robust form, short male subgenital plate, relatively short and robust caudal femora and a strikingly contrasted and longitudinally barred color pattern. The latter is mainly featured by a pronounced, broad, medio-longitudinal dark bar, pale anal angles on the tegmina, a second pale line in the distal half of the discoidal field of the tegmina and incomplete barring on the dorsal surface of the caudal femora.

*Type*.—♂; El Paso, Texas; [November, 1887]; (L. Bruner); [Hebard Collection ex Bruner, Type no. 21]. Designated by Rehn and Hebard, 1912.<sup>15</sup>

*Allotype*.—♀; same data as type.

Of the original series the type and the allotypic female are now before us, a paratypic El Paso male, in the collection of the United States National Museum, has been examined, and a paratypic female from Lerdo, Durango, Mexico, in the Hebard Collection ex Bruner, is also in hand.

The species is sharply defined and so easily recognized by the features given in the key, and by the figures, that no description is necessary. The following comments cover the more noteworthy features of variation.

*Morphological Notes*.—The variation in fastigial form found in most of the species of this genus is well exemplified in *texana*. In each of the series from Sanderson, Persimmon Gap, Pine Mountain and Prescott we find males (figured) which show a range from a moderately acute-angulate to a strongly acuminate outline. In the females this variation is rarely decided, yet occasionally we find it distinctly marked, the three females from Canyon behind Pulliam Bluff, Chisos Mountains, showing different types with well-marked extremes, the two females from Lost Mine Peak, Chisos Mountains, are very different in this respect, while the extremes of the twenty-eight Marathon females are decidedly

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<sup>15</sup> Proc. Acad. Nat. Sci. Phila., 1912, p. 62, (1912).

different. There is very considerable variation in the relative width of the pronotum, particularly in the female, the greatest width varying very decidedly in proportion to the length. This variation, in its most decided phase, has no geographic correlation, the Marathon series alone showing both the markedly different forms figured. In both sexes there is a weak but apparent tumidity of the pronotum caudad in the majority of the specimens, but more pronounced in the male. This is occasionally almost absent and there is no geographic correlation in this variation in width, nor is there any apparent correlation with the proportion of width to length.

*Synonymy.*—We have before us the unique male type of *Papagoa arizonensis* Bruner. As mentioned by Bruner, the specimen has been dried from alcohol and is greatly shrivelled. The form of the fastigium has been greatly altered, being unnaturally acute and the dorsal surface of the same part is greatly distorted. The specimen is unquestionably a male individual of *Mermiria texana*, of the general size of material of that sex from southern Arizona. The genus *Papagoa* and the species *arizonensis* must be sunk in synonymy under *texana*. Cockerell's mutation *viridis* we have not seen, but we must decry the use of technical names for such phases, as the logical outcome would be the enforced establishment of thousands of similar names in the Orthoptera, for well known and easily recognized manifestations of elementary, probably physiological and clearly non-genetic, influences.

*Measurements (in millimeters).*

♂	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Sanderson, Texas.....	25.5	3.9	20.4	14.8
Sanderson, Texas.....	26.5	4.2	22.5	16.6
Marathon, Texas.....	29.2	4.5	22.7	16.5
Marathon, Texas.....	31.5	5.1	25.6	17.5
Persimmon Gap, Texas.....	24.9	4.1	19.4	13.5
Persimmon Gap, Texas.....	29.5	4.6	24.2	17
Lost Mine Peak, Texas.....	29	4.7	24.6	17
Lost Mine Peak, Texas.....	30	5	25	18
Pine Mountain, Texas.....	25	4	20.3	14.6
Pine Mountain, Texas.....	28.3	4.8	24.4	17.9
El Paso, Texas, type.....	30.2	5	27	18.2
Franklin Mountains, Texas.....	29.2	5	25.2	17
Franklin Mountains, Texas.....	32.3	5.3	27.6	18.2
Rock House Canyon, Arizona.....	26.8	4.4	24.4	16.5
Mud Springs, Arizona.....	25.2	4.2	21	14.5
Mud Springs, Arizona.....	25.2	4	21.7	14.7
Prescott, Arizona.....	23	3.6	18.5	12.8
Prescott, Arizona.....	25.2	4	22	15.5
Mount Tritle, Arizona.....	23.8	4.1	19.4 <sup>14</sup>	13.8

<sup>14</sup> Apex incomplete.



♀	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Sanderson, Texas.....	35	5.7	27.8	20.2
Marathon, Texas.....	40.5	6	29.8	21
Marathon, Texas.....	51	7.3	35.8	25.4
Persimmon Gap, Texas.....	37	5.7	29	20.4
Persimmon Gap, Texas.....	41.2	5.9	31.6	21.9
Lost Mine Peak, Texas.....	40	6.3	31.5	21.8
Lost Mine Peak, Texas.....	43.5	6.6	32.5	24
Pine Mountain, Texas.....	40.5	6.1	29.5	21.5
Pine Mountain, Texas.....	45	6.7	31.5	23
El Paso, Texas, <i>allotype</i> .....	45	6.5	34.4	—
Franklin Mountains, Texas.....	48.5	7.2	35	23.7
Jemez Hot Springs, New Mexico.....	36.8	6.4	30.6	22
Jemez Hot Springs, New Mexico.....	43.6	6.5	32.2	23
Rock House Canyon, Arizona.....	42	6.5	32.5	23.5
Rock House Canyon, Arizona.....	44.5	6.5	32.5	22.8
Carr Canyon, Arizona.....	40	6.5	32	23.5
Carr Canyon, Arizona.....	46.5	7.5	34	24.5
Mud Springs, Arizona.....	40.5	6.2	29.5	21.5
Mud Springs, Arizona.....	41	6.2	32	22.8
Prescott, Arizona.....	32.2	5.5	26.2	19
Prescott, Arizona.....	36	6	30	21.2
Lerdo, Durango, Mexico, <i>paratype</i> .....	45.3	7.4	35.4	24.7

From these figures, which have been taken from extremes in the representations where more than two of each sex are present, it is evident that individuals are of minimum size at the higher elevations and at the periphery of the range. The Sanderson material, which, while taken at a low elevation, is from the eastern known limit of the range, and that from Mud Springs, Prescott and Mount Tritle at the western limit and quite elevated, present the minima, while specimens from Persimmon Gap, another quite eastern locality, are quite close in size; Pine Mountain, another quite elevated station, also presents uniformly small individuals. The optimum of size is developed in the Eastern Desert region (Franklin Mountains, Aden and Lerdo).

*Color Notes.*—The greenish phase of this species, which we have never seen adult, was named by Cockerell.<sup>17</sup> The description of immature individuals of both color phases has been given elsewhere by the same author.<sup>18</sup> From the present material the principal individual color variations appear to be: a fluctuation in depth of the dorso-median dark bar of the head, pronotum and proximo-sutural section of the tegmina; an occasional dark livid suffusion of the ventral half of the lateral lobes of the pronotum; a weak maculation of the tegminal intercalary area and some instability in the strength of the femoral markings. The dorsal bar ranges from nearly solid, through a type with paler center to

<sup>17</sup> Proc. Davenport Acad. Sci., ix, p. 24, (1902).

<sup>18</sup> Psyche, ix, p. 430, (1902).

an extreme with the bar itself virtually eliminated, leaving only a pair of arcuate lines on the head (lateral margins of the bar) and a median dark line on the median carina of the pronotum. The geographic color variation is largely tonal. The Sanderson and Persimmon Gap series have the pale areas quite whitish, the brown Vandyke brown; the Marathon series and those from the El Pasan region run to yellow in the pale areas, while the Arizonan series largely (but not entirely) to light pinkish buff in the same sections. The pale markings in the vicinity of the humeral trunk of the tegmina, however, are always more whitish than the other pale areas. The Pine Mountain series has a strongly intensive type of coloration, the brown being very dark (blackish brown) and the pale areas dull soiled buffy.

*Distribution.*—The range of this species extends from an undetermined point in Colorado, at least as far north as Salida and Colorado Springs,<sup>19</sup> south to northern Durango (Lerdo) and east-central Coahuila (Monclova),<sup>20</sup> Mexico; east almost to the Pecos River (Sanderson), Texas, west to central (Oak Creek Canyon), and southern (Santa Catalina, Santa Rita and Huachuca Mountains) Arizona. It doubtless extends south for a considerable distance in the central mountainous regions of northern Mexico. Its zonal range is Upper and Lower Sonoran, occurring in Upper Sonoran islands in Transition surroundings.

Its vertical distribution is, on the basis of present records and information, from 2750 feet (Sanderson, Texas) to 7000 (Pine Mountain and Lost Mine Peak, Texas) and even 7300 feet (Mount Tritle, Arizona). In Texas alone the records range from the minimum to near (7000 feet) the maximum elevations known for the species, while in Arizona the records cover localities from 3800 feet (Sabino Basin) to 7300 feet (Mount Tritle).

*Biological Notes.*—This insect is a very active one and flies quickly upon being approached. The dried specimen would hardly be called protectively colored, with its boldly striped

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<sup>19</sup> The specimen given by Scudder as "Colorado, 7000 (Morrison)" is also clearly this species. We feel quite certain it came from the more southern part of the state.

Caudell (Proc. U. S. Nat. Mus., xxvi, p. 780, (1903)) reported a pair of this species from Fort Collins, Colorado, and, with some doubt, immature material from Salida, Colorado. These specimens are now before us. The Fort Collins pair are typical of *M. maculipennis macclungi*, while a pair of immature specimens from Salida clearly represent *texana*.

<sup>20</sup> Reported as Montelovez; see comments by Hebard, Proc. Acad. Nat. Sci. Phila., 1917, p. 252, (1917).

pattern, yet in short yellow grass, or tufted bunch grass, the species is not easy to locate, often never being seen unless marked down after a flight. It is distinctly a hillside species, rarely found on dirt hills, but with a strong preference for stony or rocky slopes, with scattered cover of short grass or bunch grass, and dotted with lecheguilla (*Agave lechuguilla*), agaves (*Agave schottii* and *palmeri*), bear grass (*Nolina microcarpa*), ocotillo (*Fouquieria splendens*), sotol (*Dasyllirion leiophyllum* and *wheeleri*) and cacti. Near the upper limits of its vertical distribution it occurs in the open spots of scrub oak areas. In southern Arizona it is a species of the Desert and Encinal regions, as they have been delimited by Shreve.<sup>21</sup> In but a single case have we noted the species in flat land, then at Marathon, Texas, where two were seen on the plain some distance from the hills where individuals of the species were numerous.

The species has been taken adult as early as June 10 to 12 (Chisos Mountains, Texas) and as late as November (El Paso, Texas, and Lerdo, Durango, Mexico). The latest exact date we have is October 14 (Rock House Canyon, Arizona), immature individuals in the stage preceding maturity being taken as well as adults. It is possible the species matures earlier and persists later in the season southward at lower elevations than toward the northern limit of its range, or at higher elevations southward, but the evidence is not fully conclusive. The earliest records we have for northern New Mexico are August 10 (Las Vegas Hot Springs) and August 12 to 20 (Jemez Hot Springs), while we have adults from the border region taken from July 9 (Franklin Mountains, Texas) and 18 (Mud Springs, Arizona<sup>22</sup>) on. However, we have a single adult male from Prescott, Arizona, taken July 7, and a good series of both sexes from the same locality, taken from July 9 on. The latest date for immature specimens in the Prescott series is August 5, while we have adults taken as late as August 25. At Pine Mountain, Davis Mountains, Texas, elevation 5800 to 7000 feet, we found both adults and immature specimens common on August 31, which shows a late maturing season at an elevated locality in a relatively southern region, while, as stated above,

<sup>21</sup> Publ. 217, Carneg. Inst. Wash., pp. 15-29, (1915).

<sup>22</sup> The occurrence of adults so early, at a locality relatively so high (6800 feet), can be explained, we are certain, by slope exposure. The locality is on a warm south-facing slope, at the upper edge of the Encinal region. Shreve (Publ. 217, Carneg. Inst. Wash., p. 97 et seq., (1915)) has carefully analyzed the role of slope exposure in the Santa Catalina Mountains.

immature specimens were also present at Rock House Canyon, Arizona, on October 14. Identifiable immature specimens are before us, taken July 7 (Prescott, Arizona) and July 8 to 11 (Sabino Basin, Arizona).

*Specimens examined:* 349; 187 males, 127 females, 13 immature males, 22 immature females.

TEXAS: Sanderson, Terrell County, 2750 to 3180 feet; VIII, 25, 1912; (R. & H.; scarce in sotol (*Dasyllirion*) and grasses in bed of canyon water course and in similar situations on adjacent steep slopes); 7 ♂, 1 ♀. Marathon, Brewster County, 3940 to 4160 feet; VIII, 26 to 27, IX, 12 to 13, 1912; (R. & H.; very common on rocky hillsides, especially toward top, two seen on plain far from hills); 22 ♂, 17 ♀; VIII, 20, 1916, (R.; relatively common on hill slopes); 4 ♂, 6 ♀; [Hebard Cln.]. Persimmon Gap, Santiago Mts., Brewster County, IX, 3 and 10, 1912; (R. & H.; near grass tufts on rocky hillside with much lecheguilla, *Agave lechuguilla*); 11 ♂, 2 ♀. Between Neville Spring and Government Spring, Chisos Mts. slope, Brewster County, 3600 to 3800 feet; IX, 5, 1912; (R. & H.; on slope with little grass and much lecheguilla, yucca and creosote bush, *Covillea*); 1 ♀. Chisos Mts., Brewster County, VI, 10 to 12, 1908, (Mitchell and Cushman; at light), 1 ♂; [U. S. N. M.]: VII, 1911, (H. A. Wenzel); 3 ♂, 7 ♀; [A. N. S. P.]. Moss Well, Chisos Mts., Brewster County, 4500 to 5000 feet; IX, 5 to 8, 1912; (R. & H.; scarce in grasses on hillside, immatures common); 2 ♂, 1 ♀, 1 juv. ♂, 2 juv. ♀. Canyon behind Pulliam Bluff, Chisos Mts., Brewster County, 4600 to 5000 feet; IX, 7, 1912; (R. & H.; in high grass and sotol); 2 ♂, 3 ♀. Lost Mine Peak, Chisos Mts., Brewster County, 5500 to 7000 feet; IX, 7, 1912; (R. & H.; in open places of oak scrub on steep slope, few above 6000 feet); 7 ♂, 2 ♀. Alpine, Brewster County, IX, 8, 1911; (F. C. Bishopp); 1 ♀; [U. S. N. M.]. Puertacitas Mts., Presidio County, 5100 to 5200 feet; VIII, 31, 1912; (R. & H.); 1 ♂. Pine Mountain (slope), Davis Mts., Jeff Davis County, 5800 to 7000 feet; VIII, 29, 1912; (R. & H.; common in high bunch grass); 22 ♂, 4 ♀, 7 juv. ♀. Sierra Blanca, El Paso County, 4750 feet; IX, 14, 1912; (R. & H.; on slopes of low desert hill); 1 ♂. Quitman Mts., El Paso County, 4800 to 5400 feet; IX, 14, 1912; (R. & H.; occasional on hillside in grasses); 2 ♂, 1 ♀. Franklin Mts., El Paso County, 4500 to 5500 feet; IX, 15 to 16, 1912; (R. & H.; on barer slopes with lecheguilla, creosote bush, a few grasses and other desert plants); 10 ♂, 4 ♀.

NEW MEXICO: Jemez Hot Springs, Sandoval County; VIII, 12 to 20, 1913, IX, 17, 1914; (John Woodgate); 4 ♀; [Hebard Cln.].

ARIZONA: Prescott, Yavapai County, 5400 to 5600 feet; VIII, 14 to 24, 1917; (J. A. Kutsche); 3 ♂, 2 ♀; VII, 7 to VIII, 25, 1917; (O. C. Poling); 68 ♂, 54 ♀, 5 immature ♂, 7 immature ♀; [Hebard

Cln.]. Near Battle Mountain, near Prescott, Yavapai County; VIII, 18, 1917; (J. A. Kusche); 4 ♂, 4 ♀; [Hebard Cln.]. Near Granite Peak, Sierra Prieta, Yavapai County; VIII, 17, 1917; (J. A. Kusche); 3 ♂, 1 ♀; [Hebard Cln.]. Mount Tritle, Yavapai County, 7300 feet; VIII, 27 to 28, 1917; (J. A. Kusche); 1 ♂; [Hebard Cln.]. Rock House Canyon, Chiricahua Mts., Cochise County, 4600 feet; X, 14, 1910; (R. & H.; in high grasses among great rocks); 1 ♂, 3 ♀, 2 immature ♂, 1 immature ♀. Santa Rita Mts., 5000 to 8000 feet; (Snow); 7 ♂, 3 ♀; [Univ. of Kansas]. Mud Springs, Santa Catalina Mts., Pima County, 6800 feet; VII, 18 and 19, 1916; (Lutz and Rehn; immature and adults moderately common on slopes under oaks and on crumbling rocks); 5 ♂, 6 ♀, 1 immature ♂, 3 immature ♀; [A. M. N. H. and A. N. S. P.]. Sabino Basin, Santa Catalina Mts., Pima County, 3800 feet; VII, 8 to 11, 1916; (Lutz and Rehn; on slopes with bunch grass, lecheguilla, agave and bear grass (*Nolina*); 1 immature ♂, 1 immature ♀, [A. M. N. H. and A. N. S. P.].

COLORADO: Salida, Chaffee County; VIII, 2, 1901; (Dyar and Caudell); 2 immature ♂, 1 immature ♀; [U. S. N. M.]. Colorado Springs, El Paso County; VII, 1877; 1 immature ♂; [U. S. N. M.].

In addition, previously recorded material from El Paso and Franklin Mountains, Texas; Aden, New Mexico; Carr Canyon, Huachuca Mountains, Arizona, and Lerdo, Durango, Mexico, has been before us.

*Mermiria neo-mexicana* (Thomas). Plate V, figs. 15-27; Plate VII, fig. 7.

- 1870. *Opomala neo-mexicana* Thomas, Proc. Acad. Nat. Sci. Phila., 1870, p. 77. [♀: Northeastern New Mexico.]
- 1873. *M[ermiria] belfragii* Stål, Recensio Orthopt., i, p. 102. [♀: Texas.]
- 1874. *Opomala neomexicana* Glover, Ill. N. Amer. Ent., Orth., pl. 16, fig. 10.<sup>22</sup>
- 1876. *Mermiria neomexicana* Scudder, Bull. U. S. Geol. Surv. Terr., ii, p. 262. [Juv.; Clear Creek Canyon and Manitou, Colorado.]
- 1897. *Mermiria neomexicana* McNeill, Proc. Davenport Acad. Nat. Sci., vi, pp. 205, 206. ["Eastern slopes of the Rocky Mountains from Wyoming to New Mexico and eastward to Georgia."]
- 1899. *Mermiria neomexicana* Scudder, Proc. Amer. Acad. Arts and Sci., xxxv, pp. 42, 43. [Pueblo, Colorado; Dallas and Bosque County, Texas.]
- 1904. *Mermiria neo-mexicana* Bruner, Biol. Cent.-Amer., Orth., ii, p. 39. [New Mexico; Texas; Villa Lerdo, Durango, Mexico.]

As we have indicated in the generic discussion of classification and in the key to the species, this species is closely related solely to *alacris*, with which it comprises Group B of the genus, and which has, however, a different, though contiguous and slightly

<sup>22</sup> This figure is extremely poor and may possibly have been taken from a discolored specimen of *texana*, instead of *neo-mexicana*. However, we have no means of checking the source of the drawing and can only let it stand in the references of *neo-mexicana*.

overlapping, area of distribution. From *alacris*, *neo-mexicana* can be chiefly distinguished by the more semi-elliptical fastigium, the sides of which converge in well-rounded curves, with the apex very broadly, or at least obtusely, rounded, and in the subgenital plate of the male being but moderately produced. The coloration of the two species is usually distinctive, but not invariably so. Very rarely, in the male sex, the fastigium will be unusually angulate in *neo-mexicana*, so much so that the separation of such specimens from *alacris* is difficult. The male subgenital plate will be found, however, to furnish a good index of the specific position of the specimen, almost invariably supported by coloration features. In their habitats the two species frequent radically different environments, *neo-mexicana* being invariably campestrian and *alacris* a species of woodland cover or recently cleared timber land, which still retains its low growth or has grown up in woodland scrub.

*Type*.—♀; Northeastern New Mexico. [United States National Museum, Type No. 1030.]

This specimen has been dried from alcohol, but the species has been correctly determined by all subsequent authors excepting Stål, who probably was unacquainted with the description of *neo-mexicana*. Measurements of the type are given below.

*Morphological Notes*.—The principal points of morphological variation are: general form; horizontal angle of fastigium and angle of face. The general form is slender, but the series from the Baboquivari Mountains, Arizona, shows an average more robust form in both sexes. This is not an absolute condition, however, but an average, as several specimens, representing both sexes, from that locality are but little different from numerous individuals taken from the entire series of the species. This greater bulk applies to depth as well as breadth, and is correlated with a generally less strongly declivent face and a broader fastigial angle. The form of the fastigium varies in both sexes to at least as decided a degree as in the other species of the genus, yet being, as a whole, shorter, broader and blunter in the Baboquivari Mountains specimens than in the others. There is, however, appreciable variation in these features in even the limited series from that locality, and in series such as those from Cisco, Marathon and Dallas, Texas, and Syracuse, Kansas, the range of variation is very pronounced in each, the extremely narrow, most acute type

looking quite different from the short, rounded sub-rectangulate extreme found in the Baboquivari Mountains individuals, and relatively closely approximated in a number of the specimens from other localities.

The angle of declivence of the facial line shows considerable variation, being, as a rule, more strongly retreating in the more slender individuals. Thus the least retreating faces are found in the more robust Baboquivari specimens, but there is very considerable variation in that series in this respect, so much so that extremes from that locality have their heads, when viewed from the side, quite different in general inclination of the face. The frontal costa varies, of course, in its width and also in its relative depth, with the greater or lesser narrowing of the general form, the quite slender specimens having the costa narrow and with the sulcus more regularly defined, deeper and, as would be expected, narrower and more sharply defined dorsad than in the more robust specimens.

The tegmina show a slight amount of variation in their relative width, but this is not at all decided. See Remarks for discussion of the value of the morphological differences.

*Synonymy*.—Stål's *belfragii* is clearly the same as Thomas' older species. The description is matched by numerous individuals in the series before us. The name was first properly synonymized by McNeill in 1897.

*Measurements (in millimeters).*

♂	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Hot Springs, South Dakota.....	29	4.4	16.9	15.6
Little Big Horn River, Montana.....	28.5	4.6	19.7	15.8
Havana, Illinois.....	32.2	4.6	20.6	18.3
Sidney, Nebraska.....	26.4	4.1	19	15.1
Sidney, Nebraska.....	27	4.4	18.6	14.4
Dodge City, Kansas.....	28.5	4.6	20.4	17.5
Dodge City, Kansas.....	31.2	4.8	20	17.1
Syracuse, Kansas.....	33.8	5.2	22	19
Syracuse, Kansas.....	34	5.1	23.3	20
Julesburg, Colorado.....	29.5	4.8	21.3	17.1
Holly, Colorado.....	37.1	5.5	24.9	19.2
La Junta, Colorado.....	29.7	5	21.8	17.6
La Junta, Colorado.....	31	5	21.3	18.6
Cache, Oklahoma.....	35.3	5	25	19.5
Mountain Park, Oklahoma.....	36.6	5.1	25.2	21.8
Summit of Mt. Sheridan, Oklahoma.....	35	5.3	24.4	21
Dallas, Texas.....	32	4.7	22.8	18.9
Dallas, Texas.....	36.5	5.6	26.4	22.3

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Kerrville, Texas.....	33	4.9	23.5	19.5
Kerrville, Texas.....	35.5	5.3	24.3	20
Cisco, Texas.....	33.1	4.8	23.3	18.9
Cisco, Texas.....	37.7	5.8	26.5	22
Amarillo, Texas.....	32	4.9	22.5	18.1
Amarillo, Texas.....	32.5	4.9	22.4	19
Marathon, Texas.....	30.6	4.6	21	17
Marathon, Texas.....	35.6	5.5	24.8	21
Sycamore Canyon, Baboquivari Mountains, Arizona.....	31.3	5	22	18.2
Sycamore Canyon, Baboquivari Mountains, Arizona.....	37	5.7	27.4	21
♀				
Hot Springs, South Dakota.....	36.5	6	23	20
Havana, Illinois.....	38.6	5.5	24.8	21
Hamburg, Iowa.....	43.7	7	28.3	24.2
Hamburg, Iowa.....	44	7	30.5	—
Southwestern Nebraska.....	41.2	6.3	26	26.8
Southwestern Nebraska.....	41.2	6.2	29	22.4
Dodge City, Kansas.....	40.2	6.1	28	23.4
Dodge City, Kansas.....	39.7	6	27	23
Syracuse, Kansas.....	39.8	6.9	29.2	23.4
Syracuse, Kansas.....	50	7.5	31.6	27.4
Dallas, Texas.....	45	7.2	31	26.2
Dallas, Texas.....	52	7.8	33.4	28.8
Kerrville, Texas.....	47.2	7	30.6	24
Cisco, Texas.....	46.6	6.5	30	25.3
Cisco, Texas.....	52.2	7.5	34	26.9
Amarillo, Texas.....	45	6.8	30	25.2
Marathon, Texas.....	44.2	6.5	38.3	25.3
Marathon, Texas.....	51.2	7.6	32.2	26.4
Northeastern New Mexico ( <i>type</i> ).....	37.3	7	25.5	22.4
Sycamore Canyon, Baboquivari Mountains, Arizona.....	50.5	8	33	26.2
Sycamore Canyon, Baboquivari Mountains, Arizona.....	51	7.8	33.2	26.9

From these measurements it is quite apparent that the species shows minimum size at the more northern and more eastern localities and the maximum size southward, at least as far as its distribution within the United States is concerned. Immediate environment appears to us to be an extremely potent factor in influencing the size of individuals, those from the relatively poorly grassed Great Plains regions being of small size, excepting when from the more heavily carpeted swales and valleys. The material from the Illinois sand areas, the most eastern locality known for the species, is of very small size, well illustrating the response of the species to a rather unfavorable environment. The optimum size development of the species is reached in northeastern Texas and south-central Oklahoma, with grassland areas of western Texas (Marathon) and southern Arizona (Sycamore Canyon), following in the large size of their representatives.



*Color Notes.*—The species shows a decided amount of variation in both general tonal color and pattern. It has well marked green and brown phases, which are generally clearly distinct, but occasionally brownish specimens will show some element of the green phase, such as the green humeral stripe. The male sex is predominately brown phase, the green phase being relatively scarce in that sex, hardly one-tenth of the series of males being in the greenish phase. The female sex is predominately green phase, about two-thirds of the female specimens examined representing that type. Our environmental data is not sufficient to warrant any statement as to the correlation of the color tones and the environment, as the information in part contradicts what would be the general assumption regarding such correlation.

The tone of the green base color varies from light chalcedony yellow (in an apparently teneral individual) through light grape yellow and yellowish citrine to cource green on the head, pronotum, pleura and caudal femora, while the humeral bar on the tegmina is always more nearly approaching one of the shades of malachite green. The Baboquivari individuals have a base color ranging from dull mustard yellow to wax yellow, with more or less distinctly marked malachite green humeral bars on the tegmina.

The tone of the brown base color varies from light ochraceous-buff through ochraceous-tawny and tawny to cinnamon-brown, in the latter condition often largely overcast with hoary white except at the normal dark bars.

The lateral postocular bars range in depth from snuff brown (teneral specimen) through kaiser brown and chestnut brown to mummy brown. The postocular bars are almost invariably well marked. A medio-longitudinal bar on the head and pronotum is occasionally (♀) or generally (♂) present, again just intimated, very rarely strongly pronounced in the female sex (one only, from Baboquivari Mountains, Arizona) and infrequently indicated only by arcuate lines of color. In numerous specimens the median carina of the pronotum is finely lined with the color of the postocular bars, but no median bar will be marked on the head or otherwise on the pronotum. This condition is connected up by numerous specimens with the uniform medio-longitudinal bar pattern.

The tegmina vary in the degree of contrast between their base color and the humeral bar. This variation, and also the degree

of contrast of the paler lining of the immediate anal angle, is much as in the other species of the genus. The depth of the coloration of the caudal tibiae is gauged by the general tone and pattern. It may be as dull as cameo brown (very dark and recessively colored female from the Illinois sand region), as light as coral red or as rich as scarlet. The latter condition is indicated only in Baboquivari Mountains, Arizona, specimens.

The small Baboquivari Mountains series is much more brilliant in coloration and averages more lineate (i. e., high percentage with medio-longitudinal bar) than any others. What Mearns has said of the mammals of an adjacent portion of the United States and northern Mexico can be noted in relation to the intensity of coloration in these individuals. "Increased intensity of coloration characterizes the mammals from the valleys containing the terminal streams of the great Yaqui River of Mexico, some of which rise on the United States side of the Boundary."<sup>24</sup> We hope to have more to say in the near future regarding the intensification of color tones and increase in contrast of patterns in Orthoptera from certain sections of the Mexican Boundary region.

*Distribution.*—The range of this species extends from the Yellowstone and Missouri Rivers region of eastern Montana and western North Dakota, south to central (Kerrville) and western (Chisos Mountains) Texas and northern Durango (Villa Lerdo), Mexico; east to north-central Illinois (vicinity of Havana and Bishop), southwestern Iowa (Hamburg), eastern Oklahoma (Cherokee Nation) and central northern Texas (Dallas region); west to southern Montana (Little Big Horn River), west-central Colorado (Clear Creek Canyon) and southern Arizona (Baboquivari Mountains). The latter region is separated from the other localities from which the species is known by an interval of about five hundred miles. This striking isolation of the Baboquivari material would be extraordinary, if it were not shared by a number of other steppe species having a similar range. The explanation of this type of distribution is yet to be found. The occurrence of areas of tall grass is, however, a controlling factor within the range of the species.

The vertical range of this species extends from at least as low as 430 feet (Dallas, Texas) to as high as 9000 feet (mouth of Clear Creek Canyon, Colorado). In Texas alone, the vertical range is definitely known to be from the minimum given above to at least

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<sup>24</sup> Bull. 56, U. S. N. M., p. 74, (1907).

4485 (Alpine) and 4500 to 5000 (Moss Well) feet. In Oklahoma it has been reported from as low as 1275 feet (Cache), while in Colorado (within its range) it occurs as low as 3460 feet (Julesburg).

*Biological Notes.*—Morse has very truthfully and concisely given this species as "characteristic of the coarse grasses of the drier parts of the prairie plains and \* \* often locally abundant." It is, however, quite at home on hills and slopes, even being considered by Bruner to be partial to hill-tops, while Gillette states it is found both within and without the foothills at Fort Collins. Hart reports it on bunch grass (*Panicum virgatum*) in blowouts between sand dunes in the Illinois sand areas, while in our experience it occurred in a variety of situations, even within the zone of oaks in the Baboquivari Mountains, Arizona, at 6000 feet elevation. The necessary requirement for its presence is a sufficient area of coarse grass, which is as attractive when sun-cured as it is when fresh. It is often taken in company with *M. maculipennis macclungi*, but is more local and generally less abundant.

The earliest exact date we have for adults is July 29 (Julesburg), although material taken that month, without exact date, from Little Big Horn River, Montana, and Chisos Mountains, Texas, is now before us. The latest date we have record of is October 6 to 9 (Sycamore Canyon, Baboquivari Mountains, Arizona). That the species persists late at relatively northern localities is evident, as we have October material, without exact date, from Hot Springs, South Dakota. Adult material taken at Dallas, Texas, on August 14 to 16 was accompanied by immature individuals, also adult males and immature females were secured at Marathon, Texas, on August 20, so it is evident that the species does not mature very much earlier southward than it does northward. Morse, in his work in Texas and Oklahoma, secured no adults before August 15 (Wichita Falls, Texas), although he had taken immature material on August 8 (Caddo, Oklahoma) and again on August 18 (Clarendon, Texas). Hart has reported immature specimens taken in Illinois on August 17 and adults on August 18 to 20. Identifiable immature material has been recorded by other authors, or is now before us, taken as early as July 3 (Clear Creek Canyon, Colorado) and as late as September 5 to 8 (Moss Well, Chisos Mountains, Texas). No adults were taken with the latter.

*Remarks.*—This species is, when due allowance is made for the variation found in all of the forms of the genus, a very plastic

one, apparently responding readily to environmental influences, in modifications of both structure and coloration. None of these tendencies, however, seem well enough established or as constant as would be required of such differential features to form adequate bases for naming geographic races. The southern Arizonan (Baboquivari Mountains) material is the more strikingly isolated of these, in its generally blunter fastigium, somewhat more robust form and prominent coloration features. However, as we have shown above, this material itself varies appreciably, and is virtually connected with the more normal condition by a number of individuals from component series of the representation before us. Until we know more concerning the species in the southwestern portion of its range, its variation there and the geographic extent of the tendencies shown by our small Baboquivari series, it is inadvisable to propose a racial name for this material. The future may show the desirability of such action, but at this writing the evidence does not warrant it.

*Specimens examined:* 248; 152 males, 87 females, 2 immature males, 7 immature females.

ILLINOIS: Havana, Mason County; (J. D. Hood); 1 ♂, 1 ♀; [U. S. N. M.]. Bishop, Mason County; VIII, 13, 1907; 1 ♂; [Ill. State Lab. Nat. Hist.].

IOWA: Hamburg, Fremont County; IX, 2, 1914; (M. P. Somes); 2 ♀; [Somes Cln.].

SOUTH DAKOTA: Hot Springs, Fall River County; X, 1888 (one specimen); 1 ♂, 1 ♀; [Hebard Cln.].

NEBRASKA: Sidney, Cheyenne County, elevation 4100 to 4300 feet; VII, 30, 1910; (R. & H.; on top and slopes of bluffs of Lodge Pole Creek); 2 ♂. Southwest Nebraska; 2 ♀; [Hebard Cln.].

KANSAS: Hill City, Graham County; 1910; (C. E. McClung); 1 immature ♂; [McClung Cln.]. Graham County; (C. E. McClung); 1 ♂, 1 ♀; [McClung Cln.]. Russell, Russell County; (C. E. McClung); 2 ♂, 1 ♀; [McClung Cln.]. Dorrance, Russell County; 1908; (C. E. McClung); 2 ♂; [McClung Cln.]. Wilson, Ellsworth County; 1910; (Pinney); 1 ♂; [McClung Cln.]. Wellington, Sumner County; (E. G. Kelly); 1 ♂; [Somes Cln.]. Dickinson County; 1908; (Robertson); 3 ♂; [McClung Cln.]. Richmond, Franklin County; 1910; (Taylor); 1 ♂; [McClung Cln.]. Kingman, Kingman County; 1911; (E. Carothers); 1 ♂; [McClung Cln.]. Barber County; (F. W. Cragin); 1 ♂, 3 ♀; [Hebard Cln.].<sup>28</sup> Dodge City, Ford County, elevation 2500 feet; IX, 13, 1909; (H.; very plentiful in areas of short grass); 10 ♂, 2 ♀. Syracuse, Hamilton County, elevation 3230 feet; IX, 12, 1909; (R. & H.; in short prairie grass); 3 ♂, 12 ♀.

<sup>28</sup> Previously recorded by Bruner.

OKLAHOMA: Mountain Park, Tillman County, elevation 1360 to 1390 feet; VIII, 22, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>26</sup> Summit of Mount Sheridan, Wichita Mountains, Comanche County, elevation 2500 feet; VIII, 24, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>26</sup> Cache, Comanche County, elevation 1275 feet; VIII, 25, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>26</sup> Cherokee Nation; VIII, 1896; 1 ♀; [U. S. N. M.].<sup>27</sup>

TEXAS: No exact locality; (Belfrage); 2 ♂; [U. S. N. M.]. Amarillo, Potter County, elevation 3600 feet; VIII, 20, 1905; (A. P. Morse); 2 ♂, 1 ♀; [Morse Cln.].<sup>26</sup> Wichita Falls, Wichita County, elevation 950 feet; VIII, 15, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>26</sup> Dallas, Dallas County, elevation 430 feet; VIII, 14 to 16, 1915; (R.; common in grasses in prairie region, immature individuals very common, female adults not numerous); 35 ♂, 7 ♀; 1 immature ♂, 4 immature ♀: IX, 25 to 26, 1912; (R. & H.; scarce in areas of tall grass); 8 ♂, 4 ♀: IX, 3 (one specimen); (Boll); 2 ♂, 3 ♀; [U. S. N. M. and M. C. Z.]. Sagamore Hill, Tarrant County, elevation 650 feet; IX, 27, 1912; (R. & H.); 2 ♀. Weatherford, Parker County, elevation 1000 to 1100 feet; IX, 23, 1912; (R. & H.); 1 ♀. Cisco, Eastland County, elevation 1450 to 1550 feet; IX, 21 to 22, 1912; (R. & H.; in grasses along stream and in meadows, locally more common than *M. maculipennis maculipennis*, with which it was associated); 12 ♂, 18 ♀. Kerrville, Kerr County, elevation 1525 to 1800 feet; VIII, 17 to 18, 1912; (R. & H.; scarce in low scant grass about low oak thickets); 2 ♂, 1 ♀. Marathon, Brewster County, elevation 3940 to 4160 feet; VIII, 20, 1916; (R.; uncommon in moister areas); 2 ♂, 2 immature ♀: VIII, 25 to 27 and IX, 12 to 13, 1912; (R. & H.; in high grasses); 35 ♂, 13 ♀. Chisos Mountains, Brewster County; VI, 1911; (H. A. Wenzel); 1 ♂; [A. N. S. P.]. Moss Well, Chisos Mountains, Brewster County, elevation 4500 to 5000 feet; IX, 5 to 8, 1912; (R. & H.); 1 immature ♀. Alpine, Brewster County; IX, 8, 1911; (F. C. Bishopp); 1 ♂; [U. S. N. M.]. MONTANA: Little Big Horn River; VII, 1883; 1 ♂; [U. S. N. M.].<sup>28</sup>

COLORADO: Julesburg, Sedgwick County, elevation 3460 to 3550 feet; VII, 29, 1910; (R. & H.; on scantily grassed hills); 1 ♂, 1 ♀. Holly, Prowers County; IX, 8, 1898; (C. P. Gillette); 1 ♂, 1 ♀; [Hebard Cln.]. La Junta, Otero County, elevation 4150 feet; IX, 11, 1909; (R. & H.; not common on poorly grassed broken limestone surface at edge of Great Plains plateau); 4 ♂, 5 ♀.

ARIZONA: Baboquivari Mountains, Pima County; (F. H. Snow); 2 ♂; [A. N. S. P.].<sup>29</sup> Sycamore Canyon, Baboquivari Mountains, Pima County, elevation 3700 to 6000 feet; IX, 6 to 9, 1910; (R. &

<sup>26</sup> Previously recorded by Morse.

<sup>27</sup> Previously recorded by Caudell.

<sup>28</sup> This specimen is labelled "Little Horn River," which is doubtless meant to be Little Big Horn River

<sup>29</sup> Previously recorded by Rehn.

H.; on grassy benches of canyon slopes to tops of ridges and, very rarely, in tall yellow grass in the zone of oaks); 6 ♂, 4 ♀.

*Mermiria alacris* Scudder.<sup>30</sup> Plate V, figs. 28-35; Plate II, figs. 1-4.

1877. *Mermiria alacris* Scudder, Proc. Boston Soc. Nat. Hist., xix, p. 30. [♂, ♀: Georgia.]

1897. *Mermiria rostrata* McNeill, Proc. Davenport Acad. Nat. Sci., vi, pp. 205, 207, pl. I, fig. 3c. [♂, ♀: Mackay, Oklahoma (Indian Territory).]

1899. *Mermiria vigilans* Scudder, Proc. Amer. Acad. Arts and Sci., xxxv, pp. 42, 43. [♂, ♀: Smithville, North Carolina.]

Comparison with *M. neo-mexicana*, the only close ally of the present species, has already been made under that form.

This species was based on a series of thirty-two males and two females, collected in "Georgia" by H. K. Morrison. Of these we have examined nineteen males and one female, all in the Scudder Collection at the Museum of Comparative Zoology with the exception of one male in the United States National Museum. We here select a single male as the lectotype.

*Single Type* (by present selection).—♂; Georgia. "Type specimen." "*Mermiria alacris* Scudd." [Scudder Collection in Museum of Comparative Zoology.]

*Morphological Notes*.—The striking morphological variational feature seen in this species is that most noticeable in the other species of the genus, i. e. the form of the fastigium. This variation is spread over the whole distribution of the species and not confined to any one region or sex. In the more rounded type the fastigium forms a rounded, approximately 70° (♀) or 65° (♂) angle, from which the variations range through all degrees of production and rounding to 42° (♀) or 33° (♂). The character of the lateral margins of the fastigium varies independently of the exact angle, being weakly arcuate to straight. The exact outline of the dorsum of the head, when seen from the side, the degree of decurving of the fastigial line, the exact form of the outline of the eye and the exact location of the fastigial impression are all variable and, apparently, always individually. The eyes show similar extremes of this variation to those occurring in *intertexta*, while the presence or absence of the weak fastigial medio-

<sup>30</sup> The immature material from Nugent, Mississippi, recorded by Morse as *Mermiria bivittata* (Carneg. Inst. Wash. Publ., No. 68, p. 28, (1907)), represents, instead, the present species. The adult material there recorded is, however, true *bivittata*. It is highly probable that the immature specimens recorded at the same time from Biloxi and Hattiesburg, Mississippi, also represent *alacris*, as *bivittata* is, apparently, an earlier maturing species, but we have only immature material from Nugent, kindly loaned by Prof. Morse, before us.

longitudinal carina has no taxonomic significance. McNeill's *rostrata* was based on individuals with the very acute fastigium, but the extensive material now before us shows this condition to be purely individual.

*Synonymy*.—The synonymy given above is very evident to anyone having before them the typical material of the "species," or even topotypic males. Morse<sup>1</sup> and Rehn and Hebard<sup>2</sup> have already established the synonymy of *vigilans*, which further study has fully confirmed. McNeill's *rostrata* has been the subject of considerable study, particularly as nearly topotypic material showed in part a more acute fastigial form than the average of *alacris*. A careful analysis of the extensive series before us, covering the whole known range of *alacris*, shows clearly and most convincingly that similarly very acute fastigii are found at practically every locality represented by a fair series, and also that Oklahoma and north Texas material is as variable, in this respect, as that from other regions. The variation in the Oklahoma and Texas individuals embraces types with the fastigial angle as rounded as in the more average eastern material. The whole range of fastigial variation is similar to and co-extensive with that occurring in all the other species of the genus. The other features given as diagnostic of *alacris* and *rostrata* by McNeill are variable and untrustworthy. That author had but five specimens of the two "species" before him at the time, so there is little wonder he was led to assign erroneous values.

*Measurements (in millimeters).*

♂	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
New Berne, North Carolina.....	35.3	6	28	22
New Berne, North Carolina.....	37.2	6	26	20
Southern Pines, North Carolina....	28	4.8	20.8	17.4
Southern Pines, North Carolina....	34	5.4	25.2	19.6
Winter Park, North Carolina.....	32.2	5.2	22.8	18
Winter Park, North Carolina.....	37	5.7	25.7	21.2
Seven Mile, South Carolina.....	36	6.1	26	21.2
Seven Mile, South Carolina.....	39.4	6.5	26.7	21.2
Groveland, Georgia.....	37	5.3	25.1	19.6
Groveland, Georgia.....	39	5.6	27.3	22
Bainbridge, Georgia.....	34	5.4	25	18.8
Bainbridge, Georgia.....	37	5.4	26.5	19.5
Jacksonville, Florida.....	35	5	24	19.5
Jacksonville, Florida.....	36	6	27	20.5
Pomona, Florida.....	36.2	6.1	26.5	20.9

<sup>1</sup> Carneg. Inst. Wash., Publ. No. 68, p. 27, (1907).

<sup>2</sup> Proc. Acad. Nat. Sci. Phila., 1916, p. 156, (1916).

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Pomona, Florida.....	39.5	6.4	28.5	22.4
Gainesville, Florida.....	35.5	5.2	24.6	19.2
Cedar Keys, Florida.....	34.6	5.2	25	18.4
Fort Myers, Florida.....	32.5	5	23.6	18
Fort Myers, Florida.....	38	5.7	26	21
DeFuniak Springs, Florida.....	37.5	5.8	26.5	21.5
DeFuniak Springs, Florida.....	38.3	5.7	28.2	20.4
St. Elmo, Alabama.....	39.8	6	26.2	21
St. Elmo, Alabama.....	42	6.5	29.8	21.4
Alexandria, Louisiana.....	36.2	5.7	25.3	21.2
Alexandria, Louisiana.....	37	5.7	27.3	21
Elkhart, Texas.....	37	6	27	21.6
Elkhart, Texas.....	40	6.4	28.4	22.9
Dallas, Texas.....	37	5.3	27.7	20.3
Dallas, Texas.....	40.5	6.4	29.6	23.1
Shawnee, Oklahoma.....	39.6	6.2	27.2	21.7
Waurika, Oklahoma.....	36	5.6	26.4	20.4
Hollister, Missouri.....	33.5	5.2	23.4	18.9
♀				
New Berne, North Carolina.....	48.2	8	34	26.5
Southern Pines, North Carolina.....	40.2	6.5	30	22.5
Southern Pines, North Carolina.....	46.3	7.4	34	25.2
Winter Park, North Carolina.....	47	7.8	34	25.4
Winter Park, North Carolina.....	52.8	8	35.5	26.2
Seven Mile, South Carolina.....	52.2	8.6	36	26.8
Seven Mile, South Carolina.....	52.7	9.2	37.3	29.2
Groveland, Georgia.....	55	8.4	35	26.5
Bainbridge, Georgia.....	45	7.5	31	25.4
Bainbridge, Georgia.....	49.2	7.7	34.5	27
Jacksonville, Florida.....	51.6	8	35.2	27.6
Jacksonville, Florida.....	53.5	8.3	35.8	26.5
Pomona, Florida.....	47.5	7.7	34	27.7
Pomona, Florida.....	53.1	8.8	35.6	28.8
Titusville, Florida.....	52.3	8.2	"	27.7
Fort Myers, Florida.....	51.4	8	36.5	27.5
Fort Myers, Florida.....	50.5	8	35.2	28.1
DeFuniak Springs, Florida.....	50	8.2	36.2	27.7
Irvington, Alabama.....	47.3	7.8	34.8	27.7
Irvington, Alabama.....	53.5	8.9	38.2	29
Alexandria, Louisiana.....	47.6	7.4	34.5	26.5
Alexandria, Louisiana.....	47.3	7.6	32.9	25.6
Dallas, Texas.....	47.5	7.5	32.4	23.8
Dallas, Texas.....	50	8.4	34.6	26.5
Wilburton, Oklahoma.....	51.5	7.9	36	27
Stillwater, Oklahoma.....	44.2	7.5	31	24.4
Hollister, Missouri.....	45.5	7	31	23.6

These measurements of extremes show there is a great amount of variation at single localities, in both sexes, but particularly in the male sex. The optimum size development of the species is found in the low coastal region of the Carolinas, and in the north Floridian and Gulf Coast regions between Jacksonville and southern Mississippi, although the material continues well above average size into northeastern Texas and eastern and south-central

" Damaged.



Oklahoma. The minimum is found in material from the northern limits of the range and inland from the eastern coast, at what is the interior limit of the species in that region. The peninsular Florida individuals show, as a whole, a faint reduction in size compared with north Floridian specimens.

*Color Notes.*—The coloration of this species is distinctive when compared with most of the others in the genus, although certain individuals of *neo-mexicana* are very similar. The latter can, however, be readily distinguished by the structural characters. The base color in *alacris* ranges from dull lemon chrome to oil yellow and cource green, rarely as dull as sulphine yellow (only in the material from Elkhart, Texas), the abdomen always clearer, purer and more decidedly yellow. The dark bars range in tone from dragon's-blood red to garnet brown, rarely to liver brown and chestnut-brown. The dark markings on the head and pronotum may be of similar depth or those on the head may be distinctly paler and less sharply marked. The usual dark medio-longitudinal line on the head, pronotum and sutural margins of the tegmina may be strongly and uniformly marked, in fact almost as decided as the lateral bars, may be obsolete on the head yet distinct on the pronotum, or may be completely absent except for a narrow lining along the median carina of the pronotum. We find that the maximum reduction of the medio-longitudinal bar is generally accompanied by a slight weakening of the lateral bars, i. e., the specimens having rudimentary medio-longitudinal bars show relatively weaker lateral bars. The tegminal continuation of the dark bar is broad and unbroken by a pale humeral line in one extreme condition, while in the other extreme the dark bar on the proximal portion of the tegmina is narrower than the humeral pale line, and distad it is weaker and suffuses but about one-half of the width of the discoidal field. The face varies from uniformly pale, except for dark lines along the lateral facial carinæ, to uniformly suffused with the color of the dark pattern. The creamy white edgings of the dark lateral head and pronotal bars, the ventral edging of the continuation of the same on the pleura and the line at the ventral edge of the genæ, pronotum and ventrad on the pleura vary in distinctness. The immature specimens show a green or (rarely) brown phase with the dark bars indicated and enclosed between cream-colored callose lines.

The palest material seen is from Alexandria, Louisiana, while specimens from Pass Christian, Mississippi, strongly approach

the Alexandria ones. The Elkhart, Texas, series is very deeply but dully colored, while the single Waurika male is also very dull. From central-northern Florida (Woodville) and southwestern Georgia (Bainbridge) westward in the Gulf Coast region the species averages paler, and with lighter greens than it does along the eastern coast from North Carolina south into peninsular Florida.

*Distribution.*—In the east the range of this species extends from as far north as central North Carolina (Salisbury and New Berne), south to south-central Florida (Iona, Fort Myers and Okeechobee, St. Lucie County), the Gulf Coast of western Florida, Alabama, Mississippi and interior Louisiana; west to northeastern Texas (Dallas, Longview and Elkhart), northwestward to central Oklahoma (Perkins, Stillwater, Shawnee and Waurika) and extreme southeastern Kansas (Independence), north in the Mississippi Valley to southern Missouri (Hollister). In the east it occurs chiefly below the Fall-line in the Coastal Plain, but immature material, clearly of this species, has been taken at Toccoa, Georgia, over one thousand feet elevation, and at Salisbury, North Carolina, while we have examined one adult from Clemson College, South Carolina, which is at an elevation of eight hundred and fifty feet. The northern limit of the species' distribution in Alabama and Mississippi remains to be determined; we feel confident, from our field experience, that it is either absent or extremely scarce in southwestern Louisiana and southeastern Texas.

The presence of areas of long- and short-leaf pine appears to exercise a decided influence on the distribution of this species, although it occurs to the northwest of the range of these trees in Oklahoma.

*Biological Notes.*—This beautiful species frequents tall grass in long- or short-leaf pine woods of rolling or flat woods type, or mixed woods; occasionally in wet woods or along the borders of swampy timbered areas. It also occurs in associated gallberry and similar bushes in its preferred environment, and persists in grasses and oak sprouts after the higher covering forest has been removed. Rarely it appears to invade old fields growing up in grasses and bushes, and rather infrequently is found in sandy barrens of low oak and pine, where it occurs in the scant grass and oak sprouts. It is a moderately strong flier and is quite adept at dodging, its conspicuous coloring not rendering it as evident as would be imagined.

The earliest date available for adults is July 16 to 29, at Spring Creek, Georgia, while an adult was taken at Augusta, Georgia, on the latter date and several others at Albany, Georgia, on August 1. We have also seen an adult specimen labelled July, taken at Billy's Island, Georgia. The Spring Creek, Augusta, and Billy's Island specimens were secured with immature specimens of the species, the latter representing two instars in each case, all being in the two instars preceding maturity excepting the immature individuals from Billy's Island, which were chiefly taken in June and much less advanced. June is the earliest month noted for the immature condition, and we have material (females in the instar preceding maturity) taken with adult individuals as late as September 13 to 15. We have seen no immature specimens taken later than August 18 (Longview, Texas) which are not in the instar immediately preceding maturity. The latest date known for adults is November 22, at Smithville, North Carolina. We have seen specimens taken during the same month at Southern Pines, North Carolina, and Titusville, Florida, while the species occurs at the most western known locality (Waurika, Oklahoma) as late as October 14. The earliest northern date for adults is August 4, at Southern Pines, North Carolina, so it is evident the species has a mature season of over three months at its northern limit of distribution in the east.

*Specimens examined:* 203; 134 males, 55 females, 2 immature males, 12 immature females.

**NORTH CAROLINA:** Southern Pines, Moore County; VIII, 4 to 25, X, 13, 1915; (A. H. Manee); 17 ♂, 6 ♀; [Hebard Cln.].

**SOUTH CAROLINA:** Clemson College, Oconee County; IX, 1 to 2, 1905; 1 ♂; [Somes Cln.]. Lane, Williamsburg County; VII, 20, 1917; (M. Hebard: in grasses in long-leaf pine woods); 1 immature ♂, 2 immature ♀; [Hebard Cln.]. Seven Mile, Charleston County; IX, 23, 1917; (R. & H.; occasional in pine woods); 6 ♂, 4 ♀.

**GEORGIA:** Groveland, Bryan County; IX, 21, 1917; (R. & H.; infrequent in undergrowth of sandy oak barrens); 5 ♂, 1 ♀. Bainbridge, Decatur County; IX, 5 to 6, 1915; (R. & H.; occasional in undergrowth of pine and oak woods, particularly in the more grassy areas); 9 ♂, 7 ♀, 1 immature ♀.

**FLORIDA:** Ocala, Marion County; IX, 19 to 20, 1917; (R. & H.; in sandy barrens and undergrowth of sandy pine and oak flat-woods); 1 ♂, 3 ♀. Pomona, Putnam County; IX, 7 to 8, 1917; (R. & H.; in undergrowth in pine woods); 2 ♂, 2 ♀. Dunnellon, Marion County; IX, 19, 1917; (R. & H.; rare in pine woods undergrowth); 1 ♀. Kissimmee, Osceola County; IX, 10, 1917; (R. &

H.; along edge of cypress bay); 3 ♂. Lakeland, Polk County; IX, 11, 1917; (R. & H.; few in pine woods undergrowth); 1 ♂, 1 ♀. Iona, Lee County; IX, 13, 1917; (R. & H.; in pine woods undergrowth); 1 ♀, 1 immature ♀. Fort Myers, Lee County; IX, 13 to 15, 1917; (R. & H.; in pine woods); 7 ♂, 2 ♀, 1 immature ♀. Okeechobee, St. Lucie County; VII, 1915; (M. Mickle); 1 immature ♀; [Hebard Cln.]. Woodville, Leon County; IX, 1, 1915; (R. & H.; moderately numerous in wire grass in long-leaf pine woods and in oak sprouts); 9 ♂, 3 ♀. Carrabelle, Franklin County; IX, 2 to 3, 1915; (R. & H.; few in grasses on edge of swampy wooded areas); 5 ♂, 2 ♀. River Junction, Gadsden County; VIII, 31, 1915; (R. & H.; few in long-leaf pine woods); 4 ♂. Grand Ridge, Jackson County; IX, 1, 1915; (R. & H.; in wire grass in long-leaf pine woods); 1 ♂. DeFuniak Springs, Walton County; VIII, 30, 1915; (R. & H.; moderately common in wire grass in long-leaf pine woods); 11 ♂, 2 ♀, 1 immature ♀. Pensacola, Escambia County; VIII, 28 to 29, 1915; (R. & H.; occasional in heavy wire grass, ground oak, etc., in long-leaf pine woods); 7 ♂, 2 ♀, 2 immature ♀.

ALABAMA: Montgomery, Montgomery County; IX, 8, 1915; (H.; in coarse grasses in park-like short-leaf pine woods on ridges); 1 ♀. Mobile, Mobile County; VIII, 26 to 27, 1915; (R. & H.; in tall grasses in long-leaf pine flat-woods); 3 ♂. Irvington, Mobile County; VIII, 26, 1915; (R. & H.; moderately common in grasses of deforested pine flat-woods); 4 ♀. St. Elmo, Mobile County; VIII, 26, 1915; (R. & H.; moderately common in heavy grasses in long-leaf pine flat-woods); 6 ♂, 2 ♀, 1 immature ♀.

MISSISSIPPI: Hattiesburg, Forest County; IX, 11, 1915; (R. & H.; in rolling, rather open long-leaf pine flat-woods); 3 ♂, 1 ♀. Pass Christian, Harrison County; VIII, 23, 1915; (R. & H.; one colony in high grasses in swampy pine woods); 3 ♂.

LOUISIANA: Alexandria, Rapides Parish; VIII, 22, 1915; (R. & H.; very locally common in tall grasses of rather open long-leaf pine-woods); 12 ♂, 2 ♀.

TEXAS: Longview, Gregg County; VIII, 18, 1915; (R. & H.; in short-leaf pine woods); 1 immature ♀. Elkhart, Anderson County; VIII, 16, 1915; (H.; in tall grass patches along border of woods, chiefly short-leaf pine); 11 ♂, 1 immature ♂, 1 immature ♀. Dallas, Dallas County; IX, 10 (on two specimens); (Boll); 3 ♂, 2 ♀; [M. C. Z.<sup>14</sup> and U. S. N. M.].

OKLAHOMA: No exact locality; (Ray Painter); 1 ♂, 1 ♀; [U. S. N. M.]. Wilburton, Latimer County; VIII, 27, 1905; (A. P. Morse); 1 ♀; [Morse Cln.].<sup>15</sup> Shawnee, Pottawatomie County; VIII, 26, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>16</sup> Stillwater, Payne County; (A. N. Caudell); 1 ♀; [U. S. N. M.].<sup>16</sup> Perkins,

<sup>14</sup> The two males and one female from the Scudder Collection [M. C. Z.] are labelled "neomexicana" in Scudder's handwriting. They are clearly *alacris*.

<sup>15</sup> Reported by Morse, *Carneg. Inst. Wash.*, Publ. 68, p. 27, (1907).

<sup>16</sup> Reported by Caudell, *Trans. Amer. Entom. Soc.*, xxviii, p. 84, (1902).

Payne County; VIII, 13, 1901; (N. Caudell); 1 ♀; [U. S. N. M.].  
Waurika, Jefferson County; X, 14, 1909; (F. C. Bishopp); 1 ♂;  
[U. S. N. M.].

KANSAS: Independence, Montgomery County; VIII to IX,  
1902; (A. Birchfield); 1 ♀; [U. S. N. M.].

MISSOURI: Hollister, Taney County; VIII, 1909 and 1913;  
(M. P. Somes); 1 ♂, 1 ♀; [Somes Cln.].

Rehn and Hebard have recorded the species from the following  
localities: Fayetteville, New Berne, Southern Pines, Wilmington,  
Winter Park, Wrightsville and Lake Waccamaw, North Carolina;  
Columbia, Ashley Junction and Yemassee, South Carolina;  
Toccoa, Augusta, Macon, Jesup, Billy's Island, Albany, Bain-  
bridge and Spring Creek, Georgia; Jacksonville, Pablo Beach,  
San Pablo, Gainesville, Cedar Keys, and Titusville, Florida.

*Mermiria intertexta* Scudder. Plate VI, figs. 5-14.

1897. *Mermiria bivittata* McNeill (in part), Proc. Davenp. Acad. Nat. Sci.,  
vi, pp. 204, 205. [Apparently the single Virginia record applies to this  
species.]

1899. *Mermiria intertexta* Scudder, Proc. Amer. Acad. Arts and Sci.,  
xxxv, pp. 41, 42. [♂, ♀: Georgia; Eagle Pass, Texas.]

1904. *Mermiria intertexta* Bruner, Biol. Cent.-Amer., Orth., ii, p. 39.  
[Eagle Pass, Texas.]

This striking species occupies a rather intermediate position  
between the two types of the genus, having appreciable, though  
not strongly marked, lateral carinæ on the dorsum of the pro-  
notum, yet lacking supplementary carinæ on the lateral lobes of  
the pronotum. The form is very elongate, with the pronotum  
unusually elongate, yet regularly, though weakly, enlarging caudad.  
The species is entirely hygrophilous, and as far as known, found  
only on the eastern and Floridian coasts.

*Type*.—♂; Georgia. (Morrison.) [Scudder Collection.] *Allo-*  
*type*.—♀; same data.

The species was based on two males and two females from  
Georgia and Eagle Pass, Texas (Schott), all in the Scudder Col-  
lection. Of these we have examined two males and one female  
from the former locality.<sup>27</sup>

The present species, like *M. texana*, is so sharply defined from  
the other forms of the genus that, with the basic differential fea-

<sup>27</sup> We have not had an opportunity recently to examine the single female  
recorded from Eagle Pass, Texas. There is every reason to suppose it belongs  
to *M. maculipennis maculipennis*, and has nothing to do with the present species,  
which, in habitat, is absolutely foreign to that locality. The specimen recorded  
by Caudell (Mus. Brooklyn Inst. Arts and Sci., Sci. Bull., i, p. 110, (1904))  
from the Brownsville region, Texas, as this species, is now before us, and, as  
we had suspected, represents *M. maculipennis maculipennis*.

tures of the species in mind, *intertexta* will not be confused with any other, while its hygrophilous tendencies also serve as an additional aid to its recognition.

*Morphological Notes.*—In every series of any size of this species we find the most striking extremes in the variation in the outline of the fastigium, particularly of the males. We have figured the extremes of that sex of two series, which will show more graphically than words the variability in the production, degree of angulation or roundness of the outline of the fastigium. The greater or lesser degree of projection of the fastigium has, of course, an evident influence on the form of the fastigio-facial angle, when seen from the side, and with this is correlated some variation in the shape of the basal outline of the eye, the dorso-cephalic section being more strongly acute angulate in those with the fastigium more produced, and more produced rounded in those with the fastigium relatively shorter. Aside from this, however, the form of the eyes varies decidedly and entirely individually, the greatest width contained in one extreme one and one-half times in the greatest depth of the same, and in the other extreme one and three-quarters times in the greatest depth. Considerable individual variation in the width and relative depth of the sulcation of the frontal costa is evident in the series, this being purely individual.

*Measurements (in millimeters).*

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂				
Anglesea, New Jersey.....	32	5.1	23	18.6
Anglesea, New Jersey.....	31.7	5	22.3	17.8
Cape May, New Jersey.....	30	5	22.5	17.7
Cape May, New Jersey.....	34.1	5.7	24	18.4
Millenbeck, Virginia.....	33.5	5.6	25.2	21
Wrightsville, North Carolina.....	39	5.8	27.3	22
Isle of Palms, South Carolina.....	37.7	6	25	20.9
Tybee Island, Georgia.....	36	5.6	26.2	20.5
Tybee Island, Georgia.....	42.5	6.9	29	22.7
Pablo Beach, Florida.....	26.3	5.6	25.9	20
Pablo Beach, Florida.....	40.7	6	28.8	21.9
Homestead, Florida.....	35.1	5.7	25.3	19.7
Homestead, Florida.....	39.5	6	27.5	21.2
Big Pine Key, Florida.....	32.3	5	24	18.7
Big Pine Key, Florida.....	36.7	5.9	26.4	21.5
Indian Beach, Florida.....	42	7	29.5	24.5
Indian Beach, Florida.....	40.6	6.4	27.8	22.6
Cedar Keys, Florida.....	36.5	5.5	25.5	22.3
Cedar Keys, Florida.....	38.2	5.8	25	20.5
♀				
Anglesea, New Jersey.....	46.5	8	32.5	26
Anglesea, New Jersey.....	47.3	8	34.2	26.9

	Length of body.	Length of pronotum	Length of tegmen.	Length of caudal femur.
Cape May, New Jersey.....	46.5	7.6	33.3	25.3
Cape May, New Jersey.....	48.6	8.7	34.6	28
Millenbeck, Virginia.....	40.5	8.2	35.8	28.4
Smith Island, North Carolina.....	55	9.5	40	30.3
Isle of Palms, South Carolina.....	53	9	38.3	31.2
Tybee Island, Georgia.....	53.2	8.3	37.3	28
Tybee Island, Georgia.....	57.6	9	42	30.5
Pablo Beach, Florida.....	48	8	35	25.9
Pablo Beach, Florida.....	55	9	36.9	29
Homestead, Florida.....	53.4	8.5	37.3	27.7
Big Pine Key, Florida.....	58.5	8.9	37.4	30.4
Indian Beach, Florida.....	54.2	9.2	39.5	30
Cedar Keys, Florida.....	52.5	9	37.7	30

These measurements, which represent the maximum and minimum where series are available, show there is an average increase in size southward from New Jersey to northern and central Florida, the New Jersey individuals being far and away the minimum in the average of the measurements, while the optimum development of the species is apparently reached in the Georgian and north and central Floridian coast regions. There is, however, at each locality represented by a series, sufficient variation in the material to show that measurements of single individuals are of little value, except where they show the actual maximum or minimum of the species at that locality.

*Color Notes.*—The species exhibits two color phases, green and brown, between which stand certain individuals annectant in their tonal coloration. The green tone ranges from as pale as olive-yellow and as brilliant as clear dull green-yellow to as dull as citron green, while in the brown phase we find the tonal value connected with the greens and ranging as dark as tawny-olive. The dark markings are always more decided in the male and range from dresden brown to mummy brown. The medio-longitudinal stripe of the head and pronotum is always more apparent in the male, rarely as sharply indicated, and never as solid and dark, in the female as in the male, being entirely absent in several of the former sex. It is occasionally limited to the head and also divided longitudinally by a thread of the pale base color. The dark lateral bars are occasionally very weak in strongly green phase females, and never are as strongly marked in the female as in the male. Rarely the pale subcostal tegminal streak is obsolete. Rehn and Hebard<sup>28</sup> already have given notes on the south Florida material here examined.

<sup>28</sup> Proc. Acad. Nat. Sci. Phila., 1914, p. 390, (1914).

*Distribution.*—In the maritime region from southern New Jersey (as far north as Ocean City), south to the Florida Keys (Long Key, Big Pine Key), and northwestward along the coast of western Florida as far as Cedar Keys. The species has also been reported from the Brownsville region (Caudell) and Eagle Pass (Scudder), Texas, but we know the former is incorrect, really referring to *M. maculipennis maculipennis*, and the latter is in all probability an erroneous association, as extensive field work by Rehn and Hebard in that region, and in the whole stretch of Gulf territory intervening between the Rio Grande and Cedar Keys has failed to bring the species to light.

*Biological Notes.*—This species is distinctly hygrophilous, found in both fresh and salt marsh situations, occasionally straying into adjacent dune vegetation. Its preference is for coarse high grasses and reeds in open marsh or marshy depressions, occasionally in more strictly bog conditions (Belleplain) or narrow wet drains (Pablo Beach), while it has been taken in dry areas of low oak, bayberry, palmetto and briars among dunes near extensive salt marsh areas (Isle of Palms), and also in bayberry tangles on sand dunes in New Jersey (Cape May). Morse<sup>2</sup> has well said: "It is a shy and active species, flying freely and far, and on alighting dodges quickly around the grass stems to escape observation, or slipping nimbly downward and backward, seeks to hide itself."

Adults of this species have been taken as early as July 6 (Big Pine Keys, Florida) and as late as November 15 (Punta Gorda, Florida), while immature specimens have been taken as early as March 13 (Long Key, Florida) and as late as September 19 to 20 (Big Pine Key). From the northern portion of the range of the species we have no data on captures of adults earlier than August 9 (Ocean City, Virginia), and from New Jersey, August 18 to 22 is the earliest period, while September 24 is our latest date for the same region (Cape May Point). These northern records probably do not represent actual extremes either way, certainly not for last captures, but they are sufficient to show a season for adults some months longer in Florida than at the northern extremity of the range. Adults taken July 6 at Big Pine Key, Florida, were secured with immature individuals in the three instars preceding maturity. From the fact that Davis secured immature material at the same place September 19 to 20, with adults, it

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<sup>2</sup> Publ. No. 18, Carneg. Inst., p. 29, (1904).



would seem very probable that the species has more than a single breed at the southern point of its distribution.

*Remarks.*—This species has no synonymy, but it has been misidentified on several occasions, chiefly on account of the uncertainty attached to the name *bivittata*, and the efforts of authors to follow Scudder's differential features for the species of the genus. Smith reported it as *bivittata*,<sup>40</sup> and again as *vigilans*,<sup>41</sup> in the latter determination following Rehn and Hebard, who had referred Floridian material of the present species to *vigilans*.<sup>42</sup> By the proper reference of the latter to the synonymy under *alacris*, and a corrected conception of *bivittata*, we are able to clear up the uncertainty surrounding these names. In the Scudder Collection we find one male and two females bearing the same data as the type material of *intertexta*, and arranged under *bivittata*, which are clearly *intertexta*. From this material we have evidence of the extent to which Scudder's failure to recognize individual variation in this genus led him into serious difficulties. By dogmatically assuming the exact degree of fastigial angulation to be a specific criterion, he associated very different forms and disassociated material of the same species.

*Specimens examined:* Previously unreported, 91; 33 ♂, 43 ♀, 1 immature ♂, 14 immature ♀. Previously reported material listed solely as localities.

NEW JERSEY: Belleplain;<sup>43</sup> Anglesea;<sup>44</sup> Cape May;<sup>45</sup> Cape May, Cape County, VIII, 18-31, 1917, (Witmer Stone; near salt marsh and in bayberry thickets on sand dunes), 28 ♂, 40 ♀, 1 immature ♂, 13 immature ♀, [A. N. S. P.].

VIRGINIA: Millenbeck, Lancaster County, VIII, 8, 1915, (H. Fox), 3 ♂, 2 ♀, 1 immature ♀, [Hebard Cln.].

NORTH CAROLINA: Wrightsville,<sup>46</sup> Smith's Island.<sup>46</sup>

SOUTH CAROLINA: Coast;<sup>46</sup> Isle of Palms.<sup>46</sup>

GEORGIA: No exact locality;<sup>46</sup> Tybee Island.<sup>46</sup>

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<sup>40</sup> Ins. New Jersey, p. 154, (1900).

<sup>41</sup> Ann. Rep. N. J. State Mus., 1909, p. 179, (1910).

<sup>42</sup> Proc. Acad. Nat. Sci. Phila., 1907, p. 286, (1907).

<sup>43</sup> Recorded as *vigilans* by Fox (Proc. Acad. Nat. Sci. Phila., 1914, p. 487, (1914)).

<sup>44</sup> Reported by Smith as *bivittata* (Ins. N. J., p. 154, (1900)) and *vigilans* (Ann. Rep. N. J. State Mus., 1909, p. 179, (1910)).

<sup>45</sup> Reported by Rehn and Hebard (Proc. Acad. Nat. Sci. Phila., 1916, p. 157, (1916)).

<sup>46</sup> Portion of original material of Scudder.

FLORIDA: Atlantic Beach;<sup>46</sup> Pablo Beach;<sup>47</sup> Jacksonville;<sup>48</sup> South Jacksonville;<sup>48</sup> Cedar Keys;<sup>47</sup> Indian Beach, Sand Key, Pinellas County, IX, 17, 1917, (R. & H.; in area of high grass on landward border of salt marsh), 2 ♂, 1 ♀; Long Boat Key,<sup>48</sup> Useppa Island;<sup>48</sup> Miami;<sup>49</sup> Homestead;<sup>50</sup> Long Key;<sup>50</sup> Big Pine Key.<sup>50</sup>

*Mermiria bivittata* (Serville).<sup>51</sup> Plate VI, figs. 15-24.

1839. *Opsomala bivittata* Serville, Hist. Nat. Ins., Orth., p. 589. [♀: North America.]

1877. *M[ermiria] bivittata* Scudder, Proc. Bost. Soc. Nat. Hist., xix, p. 30. [Georgia.]

1897. *Mermiria bivittata* McNeill, Proc. Davenp. Acad. Nat. Sci., vi, pp. 204, 205. (In part.)

1899. *Mermiria bivittata* Scudder, Proc. Amer. Acad. Arts and Sci., xxxv, pp. 41, 42. (In part.) ["Georgia" and "Texas" records only.]

1904. *Mermiria bivittata* Morse, Publ. 18, Carneg. Inst. Wash., p. 29. [♂: Fort Barrancas, Florida.]

1907. *Mermiria bivittata* Morse, Publ. 68, Carneg. Inst. Wash., p. 28. (In part.) [♂, ♀: Cheaha [Chehawhaw] Mountain, Alabama; Nugent, Mississippi; Caddo, South McAlester and Wilburton, Indian Territory (now part of Oklahoma); Cache and Mountain Park, (in part), Oklahoma; Denison, St. Jo and Wichita Falls, (in part), Texas, records.]

1907. *Mermiria intertexta* Rehn and Hebard (not of Scudder), Proc. Acad. Nat. Sci. Phila., 1907, p. 286. [♂: Pablo Beach, Florida.]

1916. *Mermiria bivittata* Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1916, p. 157. [♀: Billy's Island, Georgia.]

*Comparison*.—This species is closely related in general appearance to *maculipennis*, and the two are often very hard to separate, particularly in the female sex. The most conspicuous feature of the species is found only in the male sex and is purely a color character, i. e., the absence of a pale subcostal stripe on the tegmina. In all the other species of the genus this is constantly indicated, although rarely subobsolete in males of *intertexta*, which, however, are quite distinct in other features. The other features of difference in this species from *maculipennis* are: the usual presence of a short, weak, cephalic median carina on the fastigium; the proportionately shorter dorsum of the fastigium in both sexes,

<sup>47</sup> Reported by Rehn and Hebard as *vigilans* (Proc. Acad. Nat. Sci. Phila., 1907, p. 286, (1907)). The material there reported by them as *vigilans* since has been correctly assigned to *bivittata*.

<sup>48</sup> Reported by Hebard (Ent. News, xxvii, p. 17, (1916)).

<sup>49</sup> Reported as *Mermiria* species by Rehn and Hebard (Proc. Acad. Nat. Sci. Phila., 1912, p. 250, (1912)).

<sup>50</sup> Reported by Rehn and Hebard (Proc. Acad. Nat. Sci. Phila., 1914, p. 390, (1914)).

<sup>51</sup> The following references may relate to this species, but their assignment cannot be made positively.

1870. *Opomala bivittata* Walker, Catal. Derm. Salt. Brit. Mus., iii, p. 507. [St. John's Bluff, Florida.] (May refer as well to *M. intertexta* or *alacris*.)

1871. *Opomala bivittata* Scudder, Rep. U. S. Geol. Surv. Nebr., p. 250. [Nebraska City, Nebraska.] (May refer as well to *M. maculipennis*.)

1872. *Opomala bivittata* Glover, Ill. N. A. Ent., Orth., pl. vi, figs. 24, 26, pl. xi, fig. 7.

and the fastigio-facial angle also more broadly rounded; the caudal margin of the pronotal disk being more distinctly angulate and the coloration with a larger percentage of green or greenish.

*Type*.—The original specimen of this species, on which Serville founded the name, was a female from "l'Amerique septentrionale," labelled by Latreille, from whose collection it was received. The description is sufficient to enable us to locate the species with fair certainty and correlated information assists further. Material in Serville's possession, similarly labelled and of similar origin, formed the basis of, among other species, *Leptysmia marginicollis*,<sup>52</sup> *Parozya clavuliger* and *Psinidia fenestralis*. As the range of these species has been fairly well mapped, and, as the region inhabited by *maculipennis* was largely unexplored, or at most unsettled, in the days of Latreille, we can feel relatively safe in considering the probable origin of the Latreille specimen as the southeastern states, where all the other species from the Latreille Collection occur, where *bivittata* as we understand it also occurs, and *maculipennis* is unknown. The present location of the Serville material is not definitely known to us.<sup>53</sup>

*Morphological Notes*.—The present species shows a relatively small degree of variation in the dorsal fastigial form, viewed from the standpoint of the genus, although there is quite an appreciable difference between the extremes found in either sex. In the male the extremes measure from about 52° to 84° in their angulation, or from a moderately acute angle to nearly a right angle, with its horizontal apex from narrowly rounded to rather broadly and bluntly rounded. The strength of the very short median carina on the cephalic section of the male fastigium varies greatly; it is never really strongly marked and is occasionally absent. The exact width of the marginal rim of the fastigium, due to the position of the intermarginal depression, varies as much in this as in the other species of the genus. In the female the angle of the horizontal apex of the fastigium varies from about 80° to 95°, or from a slightly acute to a slightly obtuse angle, with much variation in the degree and extent of the rounding of the same.

<sup>52</sup> These are placed in their modern genera.

<sup>53</sup> When comparing the description with *intertexta*, the only other species of the southeastern states to which it might apply, it is evident Serville did not have that species, as he says the postocular bars are black, while in *intertexta* they are always brown in the female, and the subcostal pale tegminal bar is so reduced and relatively weak it would not answer the description. In addition, the size of females of *intertexta* from the southeastern states is always greater than "20 lignes," as described.

The indication of the median fastigial carina in the female is as frequent as in the male, but it is generally, when present, less decided than in the other sex. When seen from the lateral aspect the fastigio-facial angle is always well rounded in the female, and rather narrowly, but still appreciably, rounded in the male. This is, in fact, one of the chief distinguishing features of the species. There is quite a little variation in the basal form of the eye, this ranging from ovoid-elliptical to narrowly elongate ovoid. The pronotum shows some little variation in the relative proportions of the dorsum of the prozona and metazona. The caudal margin of the disk of the pronotum is always angulate, broadly obtuse, varying slightly in its degree. The relative breadth to length of the pronotum shows a negligible amount of variation.

We have made a count of the caudal tibial spines of ten males and seven females, comprising the series from Navasota, Texas, with the following results:

♂	
Extremes in numbers on external margin.....	18-22
Extremes in numbers on internal margin.....	15-18
Average number on external margin.....	20
Average number on internal margin.....	16+
Greatest difference between numbers on same margin in same specimens (external).....	18-21
Greatest difference between numbers on same margin in same specimens (internal).....	16-17
♀	
Extremes in numbers on external margin.....	19-22
Extremes in numbers on internal margin.....	17-19
Average number of external margin.....	21
Average number on internal margin.....	17+
Greatest difference between numbers on same margin in same specimens (external).....	19-22
Greatest difference between numbers on same margin in same specimens (internal).....	17-18

*Synonymy.*—The species *bivittata* in the past has never been properly distinguished from *maculipennis*, and the published references to Serville's species are either erroneous (referring to *maculipennis* alone), in part correct (where the forms were not recognized as distinct), or fortuitously correct (where material of this species alone was in hand). The reference of a Pablo Beach male of this species to *intertexta* by Rehn and Hebard, in 1907, was due to the first recognition by those authors of a species distinct from true *intertexta* (then called by them *vigilans*). At that time Rehn and Hebard continued to use the name *bivittata* for the campestral species here shown to be properly called *maculipennis*.

*Measurements (in millimeters).*

♂	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Lane, South Carolina.....	29	4.9	20.5	17.4
Lane, South Carolina.....	30.3	5.2	23.5	18.5
Billy's Island, Georgia.....	33.5	5.4	23.8	18.4
Pablo Beach, Florida.....	34.3	5.7	25.2	19.6
Fort Barrancas, Florida.....	30.7	5.4	24.4	17.6
Chehawhaw Mountain, Alabama....	30	5	23.3	18
Nugent, Mississippi.....	30	5.1	21.6	17.3
Keokuk, Iowa.....	29.5	5.2	23	18.7
Keokuk, Iowa.....	30.8	5	21.5	18.2
West Point, Nebraska.....	28.3	4.6	21	17
Douglas County, Kansas.....	31 <sup>4</sup>	5	23.4	18
Douglas County, Kansas.....	30.7	4.8	20.4	16.8
Barber County, Kansas.....	33.7	5.4	25	19.5
Barber County, Kansas.....	34.8	6	24.3	20.9
Mountain Park, Oklahoma.....	32	5.2	24	19.8
Caddo, Oklahoma.....	36	6	26.3	21
Denison, Texas.....	34	5.4	25.4	20.8
Denison, Texas.....	36	5.7	26.6	21.4
Dallas, Texas.....	33.8	5.3	22.8	18.7
Dallas, Texas.....	34.3	6	25.5	21
Shovel Mountain, Texas.....	30.8	5.2	24.2	19.8
Shovel Mountain, Texas.....	32.3	5.8	25	20.3
Navasota, Texas.....	35	5.5	26	20.2
Navasota, Texas.....	35.5	6	27.5	21
Flatonia, Texas.....	31.8	5	23.8	19.5
Flatonia, Texas.....	37	6	26.2	22
Rosenberg, Texas.....	33.3	5.6	25	20.2
Rosenberg, Texas.....	34.7	6	27.3	20.4
♀				
Lane, South Carolina.....	44.2	7.3	32	25
Lane, South Carolina.....	47.2	7.8	34	25.7
"Georgia".....	43	7.3	32.3	26.7
"Georgia".....	46	8	35	27.4
Chehawhaw Mountain, Alabama....	44	6.9	34.5	25
Richmond, Kansas.....	43	7.6	31.8	26.3
Cache, Oklahoma.....	47	7.7	34.7	27.5
South McAlester, Oklahoma.....	47.5	7.7	36.7	29
Wichita Falls, Texas.....	47.3	7.5	34	28
Wichita Falls, Texas.....	51.3	8	35	30
Denison, Texas.....	48.3	8	34	28
Denison, Texas.....	49	8	35.3	28
Dallas, Texas.....	47	7	33.5	26.7
Shovel Mountain, Texas.....	39.5	7	29.7	25.4
Shovel Mountain, Texas.....	45.9	7.5	35.7	27.1
Navasota, Texas.....	48.8	7.9	34.4	28.6
Navasota, Texas.....	51.2	8.4	35.8	30.3
Flatonia, Texas.....	45.8	7.7	32.4	26.7
Flatonia, Texas.....	48.6	8	34	29
Rosenberg, Texas.....	49.6	8	34	27.2
Rosenberg, Texas.....	53.4	8.4	37	29

From these measurements it is evident that the species reaches its maximum of size in southeastern Texas and in the Red River region of northeastern Texas and southeastern Oklahoma, the

<sup>4</sup> Apex of abdomen abnormally extended.

size decreasing as one passes into higher country and northward toward the northern limit of its distribution. The material from West Point, Nebraska, northeastern Kansas and southeastern Iowa is very small, while that from elevated localities in Alabama, Oklahoma and Texas (i. e., Chehawhaw Mountain, Mountain Park and Shovel Mountain) is relatively small. Regarding the size variation in material from the eastern coast we can say but little, as the most northern material known from that region (Havelock, North Carolina) is not now available, and we possess a fair series from but a single definite locality—Lane, South Carolina. The latter shows equally small size when compared with material from the more northern points in the Mississippi Valley and interior region.

*Color Notes.*—The present species shares with *M. texana* the distinction of having a more fixed color pattern than the other species of the genus. The one striking feature of color difference is a sexual one and it is, as far as the material before us goes, absolutely constant. In the female sex the subcostal stripe is strongly indicated and relatively broad, while in the male it is entirely absent, the species being unique in this respect. The postocular bars are pronounced in both sexes, in the female almost never, and in the male usually, encroaching on the dorsum of the metazona; never, however, to the extent frequently found in *maculipennis*, and then generally in a dilute intensity. Very rarely is a medio-longitudinal bar present on the dorsum of the head and pronotum, and then it is generally limited to the head, made up of separate points and divided in two by a hair line of the general color. In certain specimens of the series in hand the medio-longitudinal line is indicated on the pronotum as well as on the head, and in those cases it is formed by an infuscation of the median carina. Rarely (three males: "Georgia," Chehawhaw Mountain, Alabama; three females; Lane, South Carolina) the median carina of the pronotum is distinctly hair-lined with fuscous, while the head has almost no indication of a line. Invariably the anal area of the tegmina, sutured of the last axillary vein, is of the pale dorsal color.

The pale base coloration of the male ranges from citron yellow (on the abdomen mustard yellow), through yellowish citrine to oil green, with a few specimens (all from Texas) ochraceous-buff to buckthorn brown. The majority of the Texan males are reed yellow. The pale base coloration of the female ranges from citron

green, through sea-foam green and antimony yellow and ochraceous-buff to pale tawny and even (very rarely) hays russet, the dorsum rarely with a ferruginous wash. The postocular bars in both sexes range from deep blackish fuscous to prout's brown, usually, but not invariably, more contrasted in the male than in the female. The dark area of the tegmina of the male ranges from weak cinnamon-brown proximad, paling distad to very weak snuff brown, to solidly blackish fuscous, as a broad, uniform continuation of the postocular bars. In the female, as in the male, the tegminal coloration is controlled by the depth of coloration of the postocular bars, and in this sex they are invariably of the same tone, regularly weakening distad, much the darkest along the proximal section of the costal margin and along the humeral trunk, thus contrasting the enclosed pale subcostal bar. Rarely, in the female sex, a maculate tendency, such as found in *maculipennis*, occurs<sup>55</sup> in variable intensity and extent. An infuscation of the face occurs more or less distinctly in numerous specimens, but it is strongly contrasted and very striking in eastern males alone. The caudal femora range in coloration from brazil red, through scarlet and carnelian red to hazel.

The geographic correlation of coloration seems best summarized by stating that intensive coloration in its maximum development, i. e. very dark postocular bars, medio-longitudinal bar, very dark tegmina and infusate face, is developed only in the southeastern states, with Kansas specimens closely approaching it, while Texan material chiefly represents the recessive type and stages approach that extreme, with a factor for maculation, such as found in *maculipennis*, becoming evident in that region. The Texan series is sufficiently extensive to show that local conditions are strong influencing coloration factors, while at the same time individual variation, chiefly in the female sex, is considerable in series as extensive as those from Flatonía, Rosenberg and Navasota.

The hays russet tone of general coloration is found in a single female from Lane, South Carolina.

*Distribution.*—The range of this species extends from eastern North Carolina (Havelock) and the higher country of northern Alabama (Chehaw Mountain), to eastern Georgia (Billy's Island) and northern Florida (Pablo Beach), westward along the Gulf Coast probably continuously to Texas; westward in which

<sup>55</sup> Wichita Falls, Tex. (1); St. Jo, Tex. (1); Shovel Mountain, Tex. (7); Flatonía, Tex. (2).

state it is distributed to the region of the Edwards Plateau (Shovel Mountain), extending south in the same state as far as Flatonia and Rosenberg, while northward the range extends to northeastern Nebraska (West Point) and southeastern Iowa (Keokuk). In the southeastern states we do not know its interior limits, as the few exact localities known are practically coastal, with the exception of Chehawhaw Mountain, northern Alabama, while from between the east coast and Texas we have but two reliable records—Fort Barrancas, Florida, and Nugent, Mississippi. In Oklahoma it extends as far westward as the western base of the Wichita Mountains (Mountain Park), and in Kansas its westward known limit is Sun City, Barber County. The only information we have regarding the occurrence of the species in the central Mississippi Valley is its capture at Keokuk, Iowa, from which evidence its presence in southern Illinois would not be surprising.

The species' occurrence within its range is now known to be governed by the presence of rich grasslands and it does not occur as far west or as high as the Great Plains region, being entirely one of the humid district. Its range in part overlaps that of *maculipennis maculipennis* in eastern Texas, Oklahoma, Kansas, Nebraska and Iowa, but, as *maculipennis* is essentially an arid land type, over most of their respective territories the other species does not occur. *Zonally bivittata* is almost entirely Austroriparian and Sabalian, occurring in the Carolinian zone only in the northwestern portion of its territory.

In vertical distribution this species ranges from sea-level (Pablo Beach and Fort Barrancas, Florida) to at least two thousand feet elevation (Chehawhaw Mountain, Alabama, 2000 to 2400 feet; St. Jo, Texas, 1140 feet; Shovel Mountain, Texas, over 1000 feet; Cache, Oklahoma, 1275 feet; Mountain Park, Oklahoma, 1360 to 1690 feet). In Texas the lowest point represented (Harrisburg) is but a few feet above sea-level.

*Biological Notes.*—All the available information shows *bivittata* to be a species frequenting areas of rich, high grass, with or without intermingled weeds, where it is at times locally very abundant, and in from distinctly maritime (Fort Barrancas and Pablo Beach, Florida) to relatively hilly or at least rolling (Mountain Park, and Cache, Oklahoma; Dallas and Shovel Mountain, Texas) environments. At Fort Barrancas it occurred in *Juncus* along a tidal inlet, at Navasota and Flatonia its preferred habitat was in or near post-oak groves or forest; at Harrisburg the grassy cover was in



open short-leaf pine woods, at Rosenberg in open park-like country with scattered huisache trees (*Vachellia farnesiana*), and at Lane it occurred in high grasses in long-leaf pine woods, where the species was locally abundant.

The earliest date we have for adults of the species is June 30 (Shovel Mountain), from which locality we have a fairly regular series of dates until September 18. By far the greater proportion of our dates are in August. One male from Keokuk, Iowa, was taken as late as October first. We have no nymphal material of the species, having secured adults only in our collecting. The species is the earliest maturing form in the eastern states, apparently having past its seasonal greatest abundance before August.

*Remarks.*—In the past this species has been universally confused with *maculipennis*, or at least with certain phases of that species, and its present recognition is largely due to the fact that the chromosome differences of the two species were recognized by Dr. C. E. McClung, who called our attention to the two forms. The external morphological differences separating them may seem trivial, particularly in view of the known variability of coloration and fastigial features in this genus, but the more one analyses these diagnostic features the more evident becomes their taxonomic importance in the present instance. The fastigium is broader, shorter and blunter than in *maculipennis*, and from the side more strongly rounded, while the median carina of the dorsum of the same is also well indicated in the male. The pronotal disk is of a different shape, with its caudal margin more angulate and less rounded. The absence of the subcostal stripe in the male is invariable in the large series now before us, and in addition the species generally has a more decided and richer green and a clearer, more transparent red brown in its coloration than the other species.

We feel no uncertainty relative to the determination of the species.

*Specimens examined:*<sup>66</sup> 225, 144 ♂, 81 ♀.

NORTH CAROLINA: Havelock.

SOUTH CAROLINA: Lane, Williamsburg County; VII, 20, 1917; (M. Hebard; locally abundant in high grasses in long-leaf pine woods); 33 ♂, 13 ♀; [Hebard Cln.].

GEORGIA: (H. K. Morrison) 6 ♂, 3 ♀; [M. C. Z. and U. S. N. M.].<sup>67</sup> Billy's Island.

<sup>66</sup> Localities previously recorded by the author or Rehn and Hebard are listed without comment.

<sup>67</sup> Portion of material reported by Scudder.

FLORIDA: Fort Barrancas, Escambia County; VIII, 3, 1903; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>48</sup> Pablo Beach.

ALABAMA: Chehaw Mountain, Talladega County, elevation 2000 to 2400 feet; VII, 13, 1905; (A. P. Morse); 1 ♂, 1 ♀; [Morse Cln.].<sup>49</sup>

MISSISSIPPI: Nugent, Harrison County; VII, 20, 1905; 1 ♂; [Morse Cln.].<sup>49</sup>

IOWA: Keokuk, Lee County; IX, 19, 1913 and X, 1, 1915; (M. P. Somes); 2 ♂, [Somes Cln.].

NEBRASKA: West Point, Cuming County; IX; 1 ♂; [Hebard Cln. ex Bruner].

KANSAS: Douglas County, 900 elevation; (C. E. McClung); 2 ♂; [McClung Cln.]. Richmond, Franklin County; 1910; (Taylor); 5 ♂, 1 ♀; [McClung Cln.]. Kingman, Kingman County; 1911; (Carothers); 1 ♂; [McClung Cln.]. Barber County; (F. W. Cragin); 2 ♂; [Hebard Cln. ex Bruner]. Independence, Montgomery County; VIII and IX, 1907; (A. Birchfield); 3 ♀; [U. S. N. M.].

OKLAHOMA: Mountain Park, Tillman County; VIII, 22, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>48</sup> Cache, Comanche County; VIII, 23, 1905; (A. P. Morse); 1 ♀; [Morse Cln.].<sup>48</sup> Perkins, Payne County; VIII, 13 and 16, 1901; (Mrs. Nellie Caudell and Vivian Cundiff); 4 ♂, 1 ♀; [U. S. N. M.].<sup>48</sup> South McAlester, Pittsburg County; VIII, 7, 1905; (A. P. Morse); 1 ♀; [Morse Cln.].<sup>48</sup> Wilburton, Latimer County; VIII, 27, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>48</sup> Caddo, Bryan County; VIII, 8, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].

TEXAS: (Belfrage); 3 ♂; [M. C. Z. and U. S. N. M.]. Wichita Falls, Wichita County; VIII, 16, 1905; (A. P. Morse); 2 ♀; [Morse Cln.].<sup>48</sup> St. Jo, Montague County; VIII, 14, 1905; (A. P. Morse); 1 ♀; [Morse Cln.].<sup>48</sup> Denison, Grayson County; VIII, 12, 1905; (A. P. Morse); 2 ♂, 4 ♀; [Morse Cln.].<sup>48</sup> Handley, Tarrant County; VIII, 3, 1905; (J. C. Crawford); 1 ♂, 1 ♀; [U. S. N. M.]. Dallas, Dallas County; (Boll); 3 ♂; [M. C. Z. and U. S. N. M.]: VIII, 14 to 16, 1915; (R.; in grassland); 1 ♂, 1 ♀. Shovel Mountain, Burnet County; VI, 30, VIII, 4 and 5, IX, 4 to 18, 1901; (F. G. Schaupp); 3 ♂, 10 ♀; [A. N. S. P.]. Hearne, Robertson County; VIII, 14 and 15, 1915; (H.; in high grass); 2 ♂. Navasota, Grimes County; VIII, 14, 1915; (H.; common in high grassy areas among post oaks); 10 ♂, 7 ♀. Flatonia, Fayette County; VIII, 19 and 20, 1912; (R. & H.; very abundant in tall bunch grass with few weeds, near post oak forest); 30 ♂, 21 ♀. Columbus, Colorado County; 1 ♂; [U. S. N. M.]. Rosenberg, Fort Bend County; VII, 25 and 26, 1912; (H.; locally very abundant in heavy weedy and grassy cover in park-like country); 25 ♂,

<sup>48</sup> Reported by Morse (see references above).

<sup>49</sup> Reported by Morse (see references above).

<sup>50</sup> Recorded by Caudell (Trans. Amer. Entom. Soc., xxviii, p. 84, 1902).

10 ♀. Harrisburg, Harris County; VIII, 13, 1915; (H.; in grassy area in open short-leaf pine woods); 1 ♂.

***Mermiria maculipennis maculipennis* Bruner.** Plate VI, figs. 25 and 26; Plate VII, figs. 1-6, 8-14.

1890. *Mermiria maculipennis* Bruner, Proc. U. S. Nat. Mus., xii, p. 54. [♂, ♀: San Antonio and Carrizo Springs, Texas.]  
 1893. *Mermiria bivittata* Townsend (not *Opsomala bivittata* Serville, 1839), Insect Life, vi, p. 31. [Sabinal, New Mexico; Las Cruces, New Mexico.]  
 1897. *Mermiria bivittata* McNeill, Proc. Davenp. Acad. Nat. Sci., vi, pp. 204 and 205. (In part.)  
 1897. *Mermiria maculipennis* McNeill, Ibid., pp. 204 and 206. [San Antonio and Carrizo Springs, Texas; Risville (err. pro Rioville), Nevada.]  
 1899. *Mermiria bivittata* Scudder, Proc. Amer. Acad. Arts and Sci., xxxv, pp. 41 and 42. (In part.) [Records from Texas, Arizona, New Mexico and probably Kansas apply to this form.]  
 1902. *Mermiria bivittata* Scudder and Cockerell (not *Opsomala bivittata* Serville, 1839), Proc. Davenp. Acad. Sci., ix, p. 24. [Sabinal, Las Cruces and Mesilla, New Mexico.]  
 1904. *Mermiria maculipennis* Bruner, Biol. Cent.-Amer., Orth., ii, p. 39, pl. i, fig. 9. [Carrizo Springs and San Antonio, Texas.]  
 1904. *Mermiria bivittata* Bruner (not *Opsomala bivittata* Serville, 1839), Ibid., p. 39. [Las Cruces and Mesilla, New Mexico; Arizona; New Mexico and Texas.]  
 1906. *Mermiria bivittata* Snow (not *Opsomala bivittata* Serville, 1839), Trans. Kansas Acad. Sci., xx, p. 36. [San Bernardino Ranch, Arizona.]  
 1907. *Mermiria bivittata* Morse, Publ. 68, Carneg. Inst. Wash., p. 28. (In part.) [The following records apply to this form: Amarillo, Bonita, Clarendon, Quanah and (part) Wichita Falls, Texas; Mountain Park (in part) and base of Mount Sheridan, Oklahoma.]

**Comparison.**—We have given under *M. bivittata* the leading features of difference between the two species, while under *M. maculipennis macclungi* we have discussed the features differentiating the latter race from the typical form of the species.

**Type.**—♀; San Antonio, Texas. June. (M. Newell.) [Hebard Collection ex Bruner, Type no. 20.]

The species was originally based on an unnumbered series of both sexes from two localities. Rehn and Hebard have already selected<sup>a</sup> the above listed specimen as the lectotype.

The type is of average size for the general region in which it was taken, and its color pattern is much like that seen in individuals in our series from Benevides and Beeville, Texas, but the tone of the pale color is very light and, in a measure at least, due to liquid immersion.

**Allotype.**—♂; Carrizo Springs, Dimmit County, Texas. June, [1885]. (A Wadgyr.) [Hebard Collection ex Bruner.]

**Morphological Notes.**—In general form the present race exhibits as a whole a more elongate and relatively slender body, when

<sup>a</sup> Proc. Acad. Nat. Sci. Phila., 1912, p. 62, (1912).

compared with *M. m. macclungi*, but much variation, often of a confusing character, is found in the large series before us. Progressive elongation and slenderness is evident in material from south-central, south to southern Texas, and in the Trans-Pecos region of the same state, particularly emphasized in specimens from the intermontane section of the Rio Grande valley, to at least as far north as Albuquerque, from the northward of which point we have no New Mexico material. From southern Arizona, on the other hand, we find the material unusually robust, in this respect paralleled by *M. neo-mexicana*, which has identical tendencies in the same region.

The variation in general form of the fastigium and of the fastigio-facial angle is parallel to that found in other species of the genus, showing similar variation in single locality series in both sexes, but, as usual, more pronounced in the male than in the female. The extremes of both sexes in three representative fair-sized series show fastigial (horizontal) angles as follows: ♂; Benevides, Texas, 63°, 72°; Dallas, Texas, 62°, 84°; Albuquerque, New Mexico, 72°, 75°; ♀; Benevides, Texas, 73°, 80°; Dallas, Texas, 82°, 88°; Albuquerque, New Mexico, 65°, 82°.

Non-typical material from northern Texas and Oklahoma shows a distinct shortening and relative broadening of the pronotum, particularly the disk, when compared with central and south Texas individuals. In typical material the caudal margin of the pronotal disk is more broadly and weakly angulate than in the non-typical material, which averages with more distinct and produced angulation. The more apparent median constriction of the disk of the pronotum, when compared with typical *M. m. macclungi*, is a feature almost invariably characteristic of *M. m. maculipennis*, while in non-typical northern Texas and Oklahoma material, particularly of the female sex, the tendency is but faintly or not at all indicated.

The caudal femora show to an extreme degree the variation in robustness frequent in the genus, and occasionally the disparity in proportion of length to breadth is very marked.

*Synonymy*.—Fortunately the species, and more particularly this form, has managed to escape synonyms, which is particularly remarkable when its great variability is known, and when the fact that it was first described from a strongly variant and non-diagnostic color phase is considered. The general practice has been either to use the name *bivittata* for the northern race here called

*macclungi*, and use *maculipennis* as a distinct name for the southern type, or to consider all inseparable under the name *bivittata*. That the latter name, as used by McNeill and Scudder, covered representatives of three forms is evident to the present day student. Caudell once recorded the species from the Brownsville region of Texas as *intertexta*.<sup>62</sup>

*Measurements (in millimeters).*

♂	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Katherine, Texas.....	32.8	5.4	25.4	20.8
Katherine, Texas.....	38.5	6	28	24
Benevides, Texas.....	29.8	4.9	22.5	18.6
Benevides, Texas.....	35.5	5.5	26.6	22.4
Gregory, Texas.....	36.4	5.6	26	22
Gregory, Texas.....	41.5	6.5	29.4	25.2
Beeville, Texas.....	35.8	5.5	27.2	21.5
Beeville, Texas.....	36	5.9	26.8	22.5
Hearne, Texas.....	32	5	24	19.4
Hearne, Texas.....	34.3	5.5	25	21.8
Carrizo Springs, Texas, <i>allotype</i> .....	35.5	6	27	21.7
Marathon, Texas.....	30	4.7	21.2	18
Marathon, Texas.....	32.8	5.4	—	20
El Paso, Texas.....	27.2	4	19.8	17.2
El Paso, Texas.....	32.5	5.5	24.2	21.5
Albuquerque, New Mexico.....	24.5	4.2	—	15.4
Albuquerque, New Mexico.....	29.4	4.9	23	18.2
Douglas, Arizona.....	33	5.4	25	19.7
Palo Alto Ranch, Arizona.....	31.2	5.6	24.5	19.8
Rioville, Nevada.....	39.4	6.3	29.7	23.5
<i>Atypical</i>				
Dallas, Texas.....	30.5	4.8	23	18.7
Dallas, Texas.....	38	6.5	28	23.5
Base of Mt. Sheridan, Oklahoma.....	33.4	5.4	24.8	19.8
Base of Mt. Sheridan, Oklahoma.....	34.2	5.5	—	21
♀				
Katherine, Texas.....	51.2	7.7	33.4	28.8
Katherine, Texas.....	54	8.2	35.4	29.8
Benevides, Texas.....	46.8	7.5	34.7	28.4
Benevides, Texas.....	51.5	8.2	36.6	31.2
Corpus Christi, Texas.....	44	7.6	33.8	27.6
Corpus Christi, Texas.....	49.6	7.8	35	30.3
Beeville, Texas.....	50	8	37.3	30
Beeville, Texas.....	55.5	8.9	38.2	30.6
Hearne, Texas.....	43.9	7	31.5	26.5
Hearne, Texas.....	47	7.2	34	27.5
San Antonio, Texas, <i>type</i> .....	47.6	8	36.4	29.3
Marathon, Texas.....	43	6.5	30.6	24.5
Marathon, Texas.....	48.4	7.4	34	28.4
El Paso, Texas.....	40.8	6.5	32.8	25.6
El Paso, Texas.....	52.3	8.1	35.5	30.4
Albuquerque, New Mexico.....	38.4	6.6	30.5	25.3
Albuquerque, New Mexico.....	43.5	7	33.4	28
Douglas, Arizona.....	47	7.5	26.7	27
Douglas, Arizona.....	52	8.7	38	28.9

<sup>62</sup> Brooklyn Inst. Arts and Sci., Sci. Bull., i, p. 110, (1904).

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Sycamore Wash, Arizona.....	49.8	7.8	34.5	26.4
Rioville, Nevada.....	50	8	36	22
<i>Atypical</i>				
Dallas, Texas.....	41	6.7	28.9	24.7
Dallas, Texas.....	48.5	8.1	37	30
Mountain Park, Oklahoma.....	47.5	7.9	34.9	28.5

From the above measurements it is evident there is a very great amount of individual size variation, while at the same time there is a certain amount of geographic correlation of this feature. The maximum sized specimens are from two regions—one, the south-central portion of Texas; the other, the Rio Colorado region of southern Nevada (Rioville). As we have but a single pair from the latter region, this condition may not be supported in a more extensive representation. The species, as well as the race, is, however, distinctly at its maximum size in the mesquite region of south and south-central Texas, west to the vicinity of Carrizo Springs. The minimum sized individuals are from the Rio Grande region of New Mexico and western Texas, these belonging to the markedly attenuate condition found in that region and discussed under "Morphological Notes." The atypical specimens from northern and north-central Texas (Dallas and Hearne) are under the average size for the form.

*Color Notes.*—The pattern variation in this form covers practically the whole gamut of such fluctuation as found in the genus, the combination of these tendencies or "unit characters" being much the same as in the other species, but the apparent strength of the pattern is very greatly altered by general tonal modifications, which probably are responses to environmental conditions. The relative intensity of the paired cephalic and pronotal post-ocular bars; the relatively solid coloration or maculate condition of the discoidal field of the tegmina, especially in the female sex; the contrast of the pale subcostal line on the tegmina; the strength, width and continuity of the median dark line on the head and pronotum, and the presence, and intensity and solidity when present, of dark barring on the dorsum of the caudal femora, as well as the depth of the coloration of the caudal tibiae, are all features which, in a series as large as the present one, show kaleidoscopic variation. Of these there appears to be some geographic correlation in the extent to which the blackish of the postocular bars extends upon the dorsum of the pronotum. In material from central and southern Texas this is usual and more extensive

and pronounced than in that from other regions, while the tendency is infrequent or almost absent in atypical or intermediate (*M. m. maculipennis* × *M. m. macclungi*) individuals. This extension is always narrower on the prozona than on the metazona, and occasionally is very broad on the latter section, leaving the pale coloration as a narrow median line, which may or may not be pencilled with a median dark line. Rarely the blackish on the metazona is pronounced only at its inner margin, and is almost separated from the lateral bars, thus forming additional longitudinal dashes of dark color. Very rarely the postocular bars are subobsolete on the metazona. The width of the actual postocular bars and their solidity are variable entirely independent of the extension of the bars, the former feature in both sexes, the latter in the female alone, the bars being invariably solid in the male sex.

Oblique infra-ocular stripes on the genæ are rarely indicated, never complete or solid. A pale area is generally present in the axillary field of the tegmina, and this is of variable width, occasionally dark along the sutural margin, producing a dark median line on the closed tegmina. The tegmina of the female in typical southern and central Texas material, and north Texas atypical material, is generally maculate to a greater or lesser degree; in material from west of those regions rarely maculate. In the male sex the tegmina are never more than weakly maculate.

One male (base of Mount Sheridan, Oklahoma) has a combination of complete broad dorsal bar and strong lateral bars, which greatly suggests *M. texana*.

In general tonal depth the central and south Texas material is strongly intensive, that from north Texas localities slightly weaker, the west Texas specimens and those from the Mesilla region, New Mexico, paler and more grayish overcast, the Albuquerque series very dull and dark, the few Arizona and Nevada specimens brilliant and clear, with light yellow and green tones.

The general pale color in the male ranges from straw yellow, through barium yellow and amber yellow, light chalcedony yellow, chalcedony yellow to light green-yellow; in the female from light ochraceous-buff, through light ochraceous-salmon, light pinkish cinnamon, dull zinc orange to tawny on one hand; and through ochraceous-buff, barium yellow, mustard yellow to primuline yellow on the other hand. The dark pattern varies from bone brown to blackish brown. The shade of the caudal tibial color

ranges from grenadine red through bittersweet orange to bittersweet pink on one hand, and through light coral red to testaceous on the other hand.

*Distribution.*—From Navasota and Hearne, east-central Texas, westward to south-central (Altar Valley and Baboquivari Mountains) and central (Fort Whipple) Arizona and southern Nevada (Rioville), and from the Mexican boundary northward typically as far as Hearne, Midland and Amarillo, Texas, and Dimmit Lake and Albuquerque, New Mexico. Material from localities ranging from Dallas, Temple, Ira and Clarendon, Texas, northward over central and western Oklahoma to central Kansas (Clarendon, Belpre and Russell) are atypical or clearly intermediate between *M. m. maculipennis* and *M. m. macclungi*.

The southern race of the species, i. e., typical *maculipennis*, is thus seen hardly to encroach upon the humid section of eastern Texas, while westward its distribution is largely controlled by suitable grasslands, these usually in bolson plains or river valleys.

The vertical distribution of the race is known to extend from approximately sea-level (Corpus Christi and Gregory, Texas) up to at least 5318 feet (Fort Whipple, Arizona). In Texas we know it ranges from the lowest localities here given to approximately 4000 feet (Marathon and Kent). The lowest locality we have for it in Arizona is 3200 feet (Palo Alto Ranch). The Oklahoma localities range between 1360 and 2700 feet above sea-level. The present geographic form, and for that matter the species, reaches sea-level only in the Rio Grande Plain, where, under semi-arid conditions, the species apparently reaches its optimum development.

*Biological Notes.*—The occurrence of this species as a whole, as throughout the genus, is governed by the distribution of grass patches or continuous grass prairie. The present race is typically one of arid and semi-arid regions and its favorite environment is associated with a number of dominant types of vegetation, as groves of high mesquite and clump *Opuntia* in southern Texas, weedy pastures and prairies in the same region, post oak groves in central Texas, associated with cat-claw (*Acacia*) in west central Texas, and about composites on river plain in the Rio Grande region of western Texas and southern New Mexico. Sun-cured grass is apparently just as attractive to *M. mac. maculipennis* as the more succulent green vegetation.



The period of adult occurrence is slightly more than four months, the earliest date being June 12 (Cotulla, Texas), the latest October 16 (El Paso, Texas). At Marathon, Texas, it occurs adult as early as July 1 and as late as September 2; Rehn and Hebard have reported it from El Paso as early as July 10 and we now have it as late as October 16 from the same locality, while we have from the adjacent Mesilla region of New Mexico material taken June 28 and 30. The span of the species in the adult condition for any one locality can be safely set at about three months. The only immature specimens we have before us were taken July 8 (Spofford and Johnstone, Texas) and August 14 to 16 (Dallas), at the latter locality accompanied by adults.

*Remarks.*—This race, the typical form of the species, is almost entirely one of the semi-arid and arid grasslands of the southwestern United States, occurring in its extreme development in such situations in the Rio Grande Plain and Fayette Prairie region of Texas, as well as in the bolson plains and river valleys of the southern portions of New Mexico, Arizona and Nevada. Southward and in the Rio Grande region it shows especially pronounced attenuation in form, while Arizona and Nevada material, limited in number though it is, shows a relatively more robust form, retaining, however, the other characteristics of the race. The optimum development of the species is apparently reached in south-central Texas, although the pair from southern Nevada is very large. In northern Texas the material of this race is less typical, the form somewhat shorter proportionately, the head blunter in general form and the pronotum not as elongate, nor the caudal angle of the disk of the same of the typical broadly rounded condition. As material from more northern localities is examined, the divergence from the southern type becomes more pronounced, until in Nebraska and in western Kansas we have typical *mac. macclungi*, which is apparently a more northern Great Plains and Great Basin representative of *maculipennis*, clearly intergrading, as stated above, when material from intervening regions is examined.

In every series of any size of atypical or intermediate material, certain specimens showing instability and, to a greater or lesser degree, the characters of one or the other extreme will be encountered. This is particularly pronounced in the three individuals from Amarillo, Texas, one male of which is essentially typical *m. maculipennis*, while the remaining pair are clearly

atypical. The Clarendon, Texas, male also strongly indicates a tendency toward *macclungi*, in a general region where merely atypical *m. maculipennis* predominates.

From the distributional data available it would seem that, in a general way, true *maculipennis* follows the river valleys northward from the region of its widest occurrence, while the higher ground, the benches and ridges, carry southward tendencies toward the more northern *macclungi*. When typical individuals of the two forms are compared they appear widely separated, but a series such as the present one shows the relationship very clearly.

*Specimens examined*: 285; 167 ♂, 118 ♀.

TEXAS: Brownsville region; 1 ♂; [B. I.].<sup>a</sup> Mission, Hidalgo County; VIII, 6, 1912; (H.; in arid section covered with high mesquite and a great variety of *Opuntia*); 1 ♀. Lyford, Cameron County; VIII, 6 and 7, 1912; (R. & H.; few in weedy field with sand spur); 1 ♀. Katherine, Willacy County; VIII, 8, 1912; (R. & H.); 5 ♂, 3 ♀. Gulf Coast of Texas; 1884; (Aaron); 2 ♂, 1 ♀; [M. C. Z. and U. S. N. M.]. Robstown, Nueces County; VIII, 9, 1912; (R. & H.; on plain of low mesquite, *Opuntia* and joint cactus, with dry yellow grass); 2 ♂. Benevides, Duval County; VIII, 9 to 10, 1912; (R. & H.; fairly numerous in cleared pasture overgrown with open stand of woody weeds); 10 ♂, 7 ♀. Corpus Christi, Nueces County; VII, 29, 1912; (H.); 3 ♂, 3 ♀. Gregory, San Patricio County; VII, 30, 1912; (H.; occasional on grassy plain with mesquite); 3 ♂. Beeville, Bee County; VII, 28, 1912; (H.; common in mesquite region with undergrowth solely of dry yellow grass); 12 ♂, 12 ♀. Victoria, Victoria County; VII, 27, 1912; (H.; occasional in field thickly grown up in grasses and other vegetation); 4 ♂, 1 ♀. Flatonia, Fayette County, 475 feet; VIII, 19, 1912; (R. & H.); 2 ♂, 2 ♀. Waelder, Gonzales County; VI, 25, 1897; (A. P. Morse); 1 ♂; [M. C. Z.]. Navasota, Grimes County; VIII, 14, 1915; (H.; in grassy areas among post oaks); 2 ♂. Hearne, Robertson County; VIII, 14 to 15, 1915; (H.; in sparsely grassed area near oak woods); 8 ♂, 3 ♀. Cotulla, Lasalle County; VI, 12, 1908; (E. S. Tucker); 1 ♀; [U. S. N. M.]. San Antonio, Bexar County; VI; (M. Newell); 1 ♀, *type*; [Hebard Collection ex Bruner]. Uvalde, Uvalde County, 1000 to 1100 feet; VIII, 21 to 22, 1912; (R. & H.; scarce on slopes among low *Acacia*); 2 ♂, 2 ♀. Carrizo Springs, Dimmit County; VI, 1885; (A. Wadgymar); 1 ♂, *allotype*; [Hebard Collection ex Bruner]. Del Rio, Valverde County, 900 to 1100 feet; VIII, 22, 1912; (R. & H.); 2 ♂, 2 ♀. Marathon, Brewster County, 3940 to 4160 feet; VIII, 1 to 2, 1916; VIII, 20, 1916; (R.; scarce in moister areas); VIII, 26 to 27 and IX, 2, 1912; (R. & H.; common everywhere on plain where high grass occurred); 9 ♂, 7 ♀. Garden Spring,

<sup>a</sup> Reported by Caudell as *M. intertexta*.

Brewster County; IX, 2, 1912; (R. & H.); 1 ♂. Kent, Culberson County; 3900 to 4200 feet; IX, 17 to 18, 1912; (R. & H.; scarce in tall grasses near water); 2 ♂, 1 ♀. El Paso, El Paso County; 3650 to 3700 feet; IX, 16, 1912 and X, 16, 1910; (R. & H.; fairly abundant in low composites along river plain); 8 ♂, 8 ♀. Midland, Midland County, 2779 feet; (R. & H.; very scarce in prairie area); 1 ♂. Amarillo, Potter County; VIII, 19, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].

NEW MEXICO: Dimmit Lake, near Roswell, Chaves County; (Cockerell); 1 ♂; [U. S. N. M.]. Mesilla, Dona Ana County; VI, 28 and 30, 1897; (A. P. Morse); 3 ♂, 1 ♀; [M. C. Z.]. Mesilla Park, Dona Ana County, 3800 feet; VII, 16 (one specimen); (Cockerell); 2 ♂, 1 ♀; [U. S. N. M. and M. C. Z.]. Las Cruces, Dona Ana County; VIII, 12; 1 ♂; [Hebard Cln.]. Sabinal, Socorro County; VIII, 7; (C. H. T. Townsend); 4 ♂, 1 ♀; [M. C. Z. and U. S. N. M.].

ARIZONA: Douglas, Cochise County; VIII; (F. H. Snow); 2 ♂, 3 ♀; [U. S. N. M. and A. N. S. P.]. Lower end of Sycamore Wash, Altar Valley, Pima County, about 3400 feet; X, 6 and 9, 1910; (R. & H.; in dry yellow grass); 1 ♀. Palo Alto Ranch, Altar Valley, Pima County, 3200 feet; X, 10, 1910; (R. & H.; in meadow of coarse green bunch grass); 1 ♂. Fort Grant, Graham County; 1882; 1 ♂, 1 ♀; [U. S. N. M.]. Fort Whipple, Yavapai County; (E. Palmer); 1 ♂; [Hebard Cln.].

NEVADA: Rioville,\* Clark County; VIII, 2, 1891; 1 ♂, 1 ♀; [U. S. N. M.].

#### Atypical

TEXAS: Ira, Scurry County; VIII, 7, 1901; (E. G. Francis); 1 ♂; [U. S. N. M.]. Amarillo, Potter County; VIII, 19, 1905; (A. P. Morse); 1 ♂, 1 ♀; [Morse Cln.].\*\* Quanah, Hardeman County; VIII, 21, 1905; (A. P. Morse); 2 ♂, 1 ♀; [Morse Cln.].\*\* Wichita Falls, Wichita County; VIII, 15, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].\*\* Byers, Clay County; VII, 1910; (Isely); 1 ♂; [U. S. N. M.]. Bonita, Montague County; VIII, 14, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].\*\* Cisco, Eastland County, 1450 to 1550 feet; IX, 21 and 22, 1912; (R. & H.; common in meadow); 9 ♂, 13 ♀.\*\*\* Weatherford, Parker County, 1000 to 1100 feet; IX, 23, 1912; (R. & H.; scarce in high grasses); 1 ♂, 1 ♀. Dallas, Dallas County; VIII, 14 to 16, 1915; (R.; common in grasses in prairie region and in fringe of low oaks and junipers, nymphs also present); 29 ♂, 25 ♀; VII, 16 (two specimens); (Boll); 6 ♂, 3 ♀; [M. C. Z. and U. S. N. M.].\*\* Sagamore Hill, Tarrant County, 650 feet; IX, 27, 1912; (R. & H.; grass patches

\* Erroneously given as Risville by McNeill, on the basis of the same material.

\*\* Recorded by Morse (Publ. 68, Carneg. Inst. Wash., p. 28, 1907) as *bivittata*.

\*\*\* A minority of this material is nearly typical, but the majority from this locality is appreciably atypical.

\*\* Quite a few of this series are nearly typical of *maculipennis maculipennis*, particularly males, but the majority are atypical, the females almost entirely so.

among skin oaks); 1 ♀. Handley, Tarrant County; VIII, 3, 1905; (J. C. Crawford); 3 ♂; [U. S. N. M.]. Bosque County; IX, 10; (Belfrage); 1 ♂; [M. C. Z.]. Temple, Beal County, 710 feet; IX, 24, 1912; (R. & H.); 2 ♀.

OKLAHOMA: Mountain Park, Kiowa County; VIII, 22, 1905; (A. P. Morse); 1 ♀; [Morse Cln.].<sup>44</sup> Base of Mount Sheridan, Wichita Mountains, Comanche County; VIII, 24, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>44</sup>

*Intermediate between M. m. maculipennis and M. m. macclungi.*

TEXAS: Clarendon, Donley County; VIII, 18, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>44</sup>

OKLAHOMA: Base of Mount Sheridan, Wichita Mountains, Comanche County; VIII, 24, 1905; (A. P. Morse); 1 ♂; [Morse Cln.].<sup>44</sup> Perkins, Payne County, VIII, 13, 1901; (Nellie Caudell); 1 ♀; [U. S. N. M.].

KANSAS: Clearwater, Sedgwick County; VIII, 1904; (F. B. Isely); 1 ♀; [U. S. N. M.]. Wichita, Sedgwick County; IX, 19, 1 ♂; [U. S. N. M.]. Belpre, Edwards County; IX, 13, 1909; (H.; in short grass); 1 ♂. Clarendon, Barton County; VII, 26, 1891; 2 ♂; [U. S. N. M.]. Dorrance, Russell County; 1910; (C. E. McClung); 1 ♀; [McClung Cln.]. Russell, Russell County; (C. E. McClung); 3 ♂; [McClung Cln.]. Wellington, Sumner County; VI, 1909; (F. G. Kelly); 1 ♀; [U. S. N. M.]. Barber County; (F. W. Cragin); 1 ♀; [Hebard Cln. ex Bruner]. Hill City, Graham County; 1909; (C. E. McClung); 2 ♂; [McClung Cln.]. Garden City, Finney County, (F. B. Milliken); 1 ♂; [U. S. N. M.].

*Mermiria maculipennis macclungi* new subspecies.<sup>44</sup> Plate VII, figs. 15-24.

1872. *Opomala bivittata* Dodge (not *Opsomala bivittata* Serville, 1839), Canad. Entom., iv, p. 15. [Between Platte River and Omaha, Nebraska.]

1877. *Opomala bivittata* Bruner (not *Opsomala bivittata* Serville, 1839), Ibid., ix, p. 144. [Nebraska.]

1897. *Mermiria bivittata* McNeill, Proc. Davenp. Acad. Nat. Sci., vi, pp. 204 and 205. (In part.) [State records from Nebraska and probably Illinois apply to this form.]

<sup>44</sup> It is not possible to determine whether the following references relate to true *bivittata* or to *mac. macclungi*.

1865. *Opomala bivittata* Thomas, Trans. Ill. State Agric. Soc., v, p. 447. [Illinois.]

1877. *Opomala bivittata* Bessey, Bienn. Rep. Iowa Agric. Coll., vii, p. 207. [Iowa.]

1880. *Mermiria bivittata* Thomas, Rep. Entom. Ill., ix, pp. 87, 92 and 97. [Illinois.]

1892. *Mermiria bivittatus* Osborn, Proc. Iowa Acad. Sci., i, pt. 2, p. 118. [Iowa.]

1897. *Mermiria bivittata* Ball, Proc. Iowa Acad. Sci., iv, p. 238. [Iowa.] Isely (Trans. Kansas Acad. Sci., xix, p. 241, (1905)) has recorded *bivittata* from Sedgwick County, Kansas, east of Fairmount and Brown County, Kansas. If these do not refer to true *bivittata*, the first two represent intermediates between *M. m. maculipennis* and *M. m. macclungi*, the last one probably *M. m. macclungi*.

1899. *Mermiria bivittata* Scudder, Proc. Amer. Acad. Arts and Sci., xxxv, pp. 41 and 42. (In part.) [State records from Nebraska, Colorado, Utah and possibly Iowa apply to this form.]
1903. *Mermiria tezana* Caudell, Proc. U. S. Nat. Mus., xxvi, p. 780. (In part.) [Material from Fort Collins, Colorado.]
1904. *Mermiria bivittata* Gillette (not *Opsomala bivittata* Serville, 1839), Bull. 94, Colo. Agr. Exp. Sta., p. 23. [Fort Collins, Laporte, Windsor, Greeley, Orchard, Julesburg, Wray, Rockyford and Holly, Colorado.]
1907. *Mermiria bivittata* Hart (not *Opsomala bivittata* Serville, 1839), Bull. Ill. State Labor. Nat. Hist., vii, p. 231. [Havana, Meredosia, Tamaroa and Chatauqua, Illinois.]
1913. *Mermiria bivittata* Vestal (not *Opsomala bivittata* Serville, 1839), Ibid., x, p. 20. [Havana, Illinois.]

This well-marked race can be distinguished in typical material from *M. mac. maculipennis* by the less attenuate and relatively more robust form, the shorter and relatively broader pronotum, which is not appreciably constricted mesad, the caudal angle of the disk of the pronotum being more distinctly produced and angulate, the eyes of the female being less prominent from the dorsum and by the generally smaller size. Under *Mer. mac. maculipennis* we have discussed the relationship and intergradation of the two forms.

*Type*.—♂; Forsyth, Rosebud County, Montana. July 27, 1909. (Morgan Hebard.) [Hebard Collection, Type No. 445.]

*Description of Type*.—Form more robust and less attenuate than in *M. mac. maculipennis*; size smaller.\* Head with fastigio-facial angle less acute, more truncate in lateral aspect, the facial line less strongly declivent. Antennæ proportionately longer, their length equal to at least four-fifths that of the caudal femora. Pronotum distinctly shorter and proportionately broader, the greatest caudal width contained about one and one-half times in the greatest length of the same, narrowing of the dorsum of the prozona less pronounced than in *M. mac. maculipennis*; caudal margin of the disk of the pronotum more distinctly, though very broadly, obtuse-angulate, with the immediate angle less rounded.

*Allotype*.—♀; same data as type. [Hebard Collection.]

*Description of Allotype*.—Form and size as in male. Antennæ proportionately longer. Pronotum distinctly shorter, and broader proportionately, the narrowing of the dorsum of the prozona less pronounced than in *M. mac. maculipennis*.

*Paratypic Series*.—We have before us fourteen males and one female, bearing the same data as the type and allotype, which we

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\* The small individuals of *M. mac. maculipennis* from the Rio Grande region, from El Paso to Albuquerque, are hardly or not at all larger than *M. mac. maculungi*, but they are distinctly more slender in every way.

consider paratypes. These are located in the Hebard Collection and that of the Academy of Natural Sciences of Philadelphia.

*Morphological Notes.*—As already shown, the present race is a shorter, relatively more robust form than *M. mac. maculipennis*. It shows much less variation in the morphological features mentioned under the typical form of the species than does the latter, while such progressive elongation and slenderness as is there evident is not found in typical *macclungi*, being apparent only in the individuals intermediate in character between *M. mac. maculipennis* and *M. mac. macclungi*. The extremes of both sexes in three representative fair-sized series show variations in the fastigial (horizontal) angle as follows: ♂; Forsyth, Montana, 71.5°, 87°; Fort Collins, Colorado, 68.5°, 76°; North Platte, Nebraska, 77.5°, 87°; ♀; Forsyth, Montana, 84.5° (no variation); Fort Collins, Colorado, 85°, 87°; North Platte, Nebraska, 80.5°, 89.5°.

*Synonymy.*—The general misidentification of this form as *bivittata* has already been discussed. Caudell's reference of Fort Collins material of this race to *M. texana* was an error in identification, as the material, now before us, shows.

*Measurements (in millimeters).*

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
♂				
Forsyth, Montana, <i>type</i> .....	26	4.5	19.7	16.3
Forsyth, Montana, <i>paratype</i> .....	26.2	4.3	18.8	16
Forsyth, Montana, <i>paratype</i> .....	29.3	5	21.6	17.4
Julesburg, Colorado.....	25.3	4.5	19.6	16
Julesburg, Colorado.....	27.3	4.3	19.7	15
Fort Collins, Colorado.....	27.2	4.4	19.2	15.9
Fort Collins, Colorado.....	30.8	4.8	20.8	16.9
Pueblo, Colorado.....	29.3	5	21.2	18.1
Pueblo, Colorado.....	32	4.9	23.6	19
Glen, Nebraska.....	21	4.2	19.7	15
Glen, Nebraska.....	27.2	4.5	19.2	16.1
North Platte, Nebraska.....	25	4.1	18.9	15.8
North Platte, Nebraska.....	27.4	4.5	19.4	16
West Point, Nebraska.....	26.1	4.5	19.8	15.6
West Point, Nebraska.....	28.4	4.9	22	17.8
Salt Lake City, Utah.....	28	4.6	18.3+	17
Salt Lake Valley, Utah.....	28.5	4.7	20.5	17.3
♀				
Forsyth, Montana, <i>allotype</i> .....	43.6	6.6	28.5	22.5
Forsyth, Montana, <i>paratype</i> .....	45	6.5	28.5	22.2
Glendive, Montana.....	41.2	6.5	27.7	21.8
Julesburg, Colorado.....	37	5.5	27.5	21.2
Fort Collins, Colorado.....	38.3	6.3	30.8	23.7
Fort Collins, Colorado.....	40.5	6.5	28.2	22.3
Pueblo, Colorado.....	40	6.7	31	25.4
Pueblo, Colorado.....	41	7	32.3	25.2
Glen, Nebraska.....	36	6.3	27	22.4

	Length of body.	Length of pronotum.	Length of tegmen.	Length of caudal femur.
Glen, Nebraska.....	41	6.4	29.7	23.2
North Platte, Nebraska.....	37.8	5.8	26	21
North Platte, Nebraska.....	42	6.5	30.2	23.9
West Point, Nebraska.....	38	6.4	27.8	22
West Point, Nebraska.....	42	6.7	29	23.5
Syracuse, Kansas.....	48.4	7	32	26
Hollister, Missouri.....	34	5.5	27	21.2
Muscatine, Iowa.....	37	6.3	30	23.2
Onawa, Iowa.....	37.7	6.5	28.5	22.5
Lone Rock, Wisconsin.....	32.7	5.4	23.8	19.5
Havana, Illinois.....	39.5	5.5	25.6	22.2
Maple Peak, Utah.....	43	7	30.5	25.4
Maple Peak, Utah.....	42.5	6.5	29.2	25
<i>Atypical</i>				
♂				
Clarendon, Kansas.....	29.5	5	20.5	17.4
Clarendon, Kansas.....	30.3	5.3	24.2	19.5
♀				
Clearwater, Kansas.....	42.8	7.5	32	25
Barber County, Kansas.....	43	7.6	34	26.5

From these measurements it is evident that while the maximum sized individuals are from the more southern portion of the range of the race, as would be expected from the average larger size of *Mer. mac. maculipennis*, the smallest specimens are, as might be inferred, from the more northern localities. Unfavorable environment may be responsible for the minimum sized individuals occurring in the sand-hill regions of Nebraska and Illinois, and the high plains region of northeastern Colorado, but peripheral depauperation may be as responsible for the Illinois cases, as well as the remarkably small size of the Hollister, Missouri; Onawa and Muscatine, Iowa and Lone Rock, Wisconsin, specimens.

*Color Notes.*—The color description of the race as a whole, based on all of our typical material, is as follows:

Base color ranging from dirty cream-buff through ivory yellow and honey yellow to olive-yellow on one hand, and through pinkish buff, cinnamon-buff and vinaceous-cinnamon to clay color on the other hand. This base color is often clearer and purer ventrad of the lateral bars on the sides of the body, slightly or distinctly suffused on the dorsum. The paired lateral bars range in tone from sepia, through bister and bone brown to brownish black. Antennae varying in tone from pale zinc orange and dull ochraceous-buff, to ferruginous and cinnamon-brown, always somewhat darkened distad; eyes ranging from hazel and dresden brown to chestnut brown; face rarely infuscate, and then not strongly so, with the adjacent portions of the genæ equally or more de-

cidedly infusate, leaving a narrow pale postocular line ventrad of the dark line; dorsum of the head rarely with a distinct medio-longitudinal dark line, which, when present, is almost never complete, being divided in two longitudinally, and when continued on the pronotum represented only by a hair line on the median carina.

Tegmina with the base color generally more grayish than the general pale color, more approximating drab, benzo brown and hair brown, the proximal half of the marginal and discoidal fields suffused to a greater or lesser degree with the dark color, this weakly maculate in the female, and in both sexes persistent distad only along the humeral trunk; subcostal stripe indicated in both sexes, ranging from sulphur yellow to aniline yellow and buckthorn brown. Caudal femora of the general color, occasionally washed with the darker color along the dorsal section of the external face; transverse dark bars on the dorsal face of the caudal femora are almost never indicated in typical material of *macclungi*, although suggested in many intermediate individuals: caudal tibiae ranging from carnelian red and mikado brown to coral red, spines black tipped.

There is a geographic correlation in color tone which is fairly evident in the case of the material from the Platte Valley in Nebraska, these being on an average distinctly paler, and this is as true of the few (4) from Kearney as for the extensive sand-hill series from North Platte. Certain other color correlations might be mentioned, but the series, in each case, is not extensive enough to warrant comment.

The extension of the dark lateral bars on the sides of the dorsum of the pronotum, as found in *Mer. mac. maculipennis*, is present in this race, but is not common, three males alone having it indicated. Material intermediate between this race and true *maculipennis* shows this more generally indicated.

*Distribution*.—From the eastern Yellowstone Valley of Montana (Forsyth and Glendive) south typically to southern Nebraska (Lincoln and Haigler), western Kansas (Syracuse), southern Colorado (Holly and Pueblo) and northern Utah (Salt Lake City and Maple Peak). The eastern limit of the range is apparently reached in south-central Wisconsin (Lone Rock), the central axis of Illinois and southern Missouri (Hollister), while westward it is unknown beyond the Utah localities given above. For data on the area occupied by intermediates between *Mer. mac. maculipennis* and *Mer. mac. macclungi* see under the former.



The vertical distribution of the form extends from as low as 454 feet (Meredosia, Illinois) to as high as 5000 to 6500 feet (Maple Peak). Northward it is known only from relatively low elevations (2515 feet; Forsyth), while in Nebraska it occurs up to about 4500 feet (Glen) and in Colorado to at least 5069 feet (Laporte).

The present form is seen to be a Great Plains and Great Basin type, spreading eastward in suitable environments under satisfactory temperature conditions.

*Biological Notes.*—Grassy patches and stretches of sparse short grass are frequented by this form, these in a variety of situations, i. e. on bench of the Great Plains (Forsyth and Julesburg), on river plain and adjacent sand-hills (North Platte), on the slopes of hills and foothills (Kearney and Salt Lake City) and on gently rolling plains (Syracuse).

The available data shows the species occurs adult as early as July 8 and as late as September 14, at the same locality (Rocky Ford, Colorado). This locality is very near the southern limit of typical material of the form, and therefore probably represents the region of maximum summer conditions within the form's range. From the more northern region the earliest date we have is July 27 (Forsyth), but the deficiency of data prevents us from giving any late records from the same region.

*Remarks.*—This typically very distinct race is the northern adaptation of *Mermiria maculipennis*, intergrading, as already shown, into true *maculipennis* in Kansas and Oklahoma, the north Texas material being much nearer typical *maculipennis* than *m. macclungi*. Its relationship to the large south Texan *maculipennis* has never been clearly indicated in the past, and material of the present form has almost invariably been recorded as *bivittata*, to which species *macclungi* is not closely related.

We take great pleasure in dedicating this interesting and striking form to Dr. C. E. McClung, of the University of Pennsylvania, who, from cytological evidence, first called our attention to this race, and also to the distinctness of true *bivittata* from the other forms with which it had been confused and associated.

*Specimens examined:* 113; 56 ♂, 55 ♀, 2 immature ♀.

MONTANA: Glendive, Dawson County; 1 ♀; [Hebard Cln. ex Bruner]. Forsyth, Rosebud County; VII, 27, 1909; (H.; in canyon in bench of plains); 15 ♂, 2 ♀, *type*, *allotype* and *paratypes*.

NEBRASKA: Valentine, Cherry County; (L. Bruner); 2 ♂; [Hebard Cln. ex Bruner and U. S. N. M.]. Chadron, Dawes County; (L. Bruner); 1 ♂, 1 ♀; [Hebard Cln. ex Bruner and

U. S. N. M.]. Fort Robinson, Dawes County; VIII, 1888; 1 ♂; [Hebard Cln. ex Bruner]. Glen, Sioux County; VIII, 6 to 20, 1903; (L. Bruner); 3 ♂, 2 ♀; [Hebard Cln. ex Bruner]. Sidney, Cheyenne County; 1 ♀; [Hebard Cln. ex Bruner]. North Platte, Lincoln County, 2850 feet; VII, 28, 1910; (R. & H.; common in short grass on river plains and adjacent sand-hills); 15 ♂, 15 ♀. Broken Bow, Custer County; VII, 1889; 1 ♀; [Hebard Cln. ex Bruner]. Kearney, Buffalo County, 2146 feet; VII, 27, 1910; (R. & H.; uncommon on hills covered with short grasses); 4 ♀. West Point, Cuming County; VII, 10, 1887 (one), IX (three); 6 ♂, 5 ♀, 1 immature ♀ (no date); [Hebard Cln. ex Bruner]. Fontanelle, Washington County; 1876; 1 ♀; [Hebard Cln. ex Bruner]. Lincoln, Lancaster County; VIII & IX; (L. Bruner); 1 ♂, 4 ♀, 1 immature ♀; [Hebard Cln. ex Bruner]. Burnham, Lancaster County; VIII, 30, 1911; (L. Bruner); 1 ♀; [Hebard Cln. ex Bruner]. Haigler, Dundy County; 1 ♂; [Hebard Cln. ex Bruner]. Stratton, Hitchcock County; VII, 14, 1899; 1 ♂; [U. S. N. M.].

COLORADO: Julesburg, Sedgwick County, 3460 to 3550 feet; VII, 29, 1910; (R. & H.; on plains escarpment scantily clothed with grass and sage); 2 ♂, 1 ♀. Poudre Canyon; VIII, 30, 1898; 1 ♂; [U. S. N. M.]. Fort Collins, Larimer County; VIII, 9, 1901; (Dyar and Caudell); 1 ♂, 1 ♀; [U. S. N. M.]<sup>70</sup>: VIII, 8 and 19, 1898; 1 ♂, 2 ♀; [Hebard Cln. and A. N. S. P.]. Denver, Denver County; (Beale); 1 ♀; [Hebard Cln.]. Pueblo, Pueblo County; VII, 28, 1878; 1 ♂, 2 ♀; [Cornell Univ. Cln.]: 4700 feet; VII, 30 and 31, 1877; 1 ♂; [M. C. Z.]. Rocky Ford, Otero County; VII, 8, 1899 and IX, 14, 1898; 1 ♂, 1 ♀; [A. N. S. P.].

KANSAS: Syracuse, Hamilton County, 3230 feet; IX, 12, 1909; (R. & H.; on plain covered with short grass); 1 ♀.

WISCONSIN: Lone Rock, Richland County; VIII, 21, 1906; 1 ♀; [Ill. State Lab. Nat. Hist.].

IOWA: Onawa, Monona County; IX, 2, 1914; (M. P. Somes); 1 ♀; [Somes Cln.]. Muscatine, Muscatine County; VII, 10, 1909; (M. R. Somes); 2 ♀; [Somes Cln.].

ILLINOIS: Havana, Mason County; VIII, 7, 1908; 1 ♀; [Ill. State Lab. Nat. Hist.].

MISSOURI: Hollister, Taney County; VIII, 1913; (M. P. Somes); 1 ♀; [Somes Cln.].

UTAH: Salt Lake City, 4500 feet; IX, 7, 1909; (R. & H.; in grasses near base of foothills); 1 ♂. Salt Lake Valley; VIII, 2, 1896; 1 ♂; [A. N. S. P.]. Maple Peak, Wasatch Mountains, Salt Lake County, 5000 to 6500 feet; IX, 7, 1909; (R. & H.); 2 ♀.

<sup>70</sup> Recorded by Caudell (Proc. U. S. Nat. Mus., xxvi, p. 780, (1903)) as *texana*.

## EXPLANATION OF PLATES V, VI, VII.

- PLATE V.—Fig. 1.—*Mermiria texana*. ♀. Pine Mountain, Davis Mountains, Texas. Lateral view. ( $\times 1\frac{1}{2}$ .)
- Fig. 2.—*Mermiria texana*. ♂. Sanderson, Texas. Lateral view of head and pronotum. ( $\times 3$ .)
- Fig. 3.—*Mermiria texana*. ♂. Sanderson, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 4.—*Mermiria texana*. ♂. Sanderson, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 5.—*Mermiria texana*. ♂. Persimmon Gap, Santiago Mountains, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 6.—*Mermiria texana*. ♂. Persimmon Gap, Santiago Mountains, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 7.—*Mermiria texana*. ♂. Pine Mountain, Davis Mountains, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 8.—*Mermiria texana*. ♂. Pine Mountain, Davis Mountains, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 9.—*Mermiria texana*. ♀. Marathon, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 10.—*Mermiria texana*. ♀. Marathon, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 11.—*Mermiria texana*. ♂. Sanderson, Texas. Dorsal view of pronotum. ( $\times 3$ .)
- Fig. 12.—*Mermiria texana*. ♀. Marathon, Texas. Dorsal view of pronotum. ( $\times 3$ .)
- Fig. 13.—*Mermiria texana*. ♀. Marathon, Texas. Dorsal view of pronotum. ( $\times 3$ .)
- Fig. 14.—*Mermiria texana*. ♂. Sanderson, Texas. Lateral view of apex of abdomen. (Greatly enlarged.)
- Fig. 15.—*Mermiria neo-mexicana*. ♀. Dallas, Texas. Lateral view. ( $\times 1\frac{1}{2}$ .)
- Fig. 16.—*Mermiria neo-mexicana*. ♂. Syracuse, Kansas. Lateral view of head and pronotum. ( $\times 3$ .)
- Fig. 17.—*Mermiria neo-mexicana*. ♂. Sycamore Canyon, Baboquivari Mountains, Arizona. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 18.—*Mermiria neo-mexicana*. ♂. Baboquivari Mountains, Arizona. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 19.—*Mermiria neo-mexicana*. ♂. Syracuse, Kansas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 20.—*Mermiria neo-mexicana*. ♂. Syracuse, Kansas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 21.—*Mermiria neo-mexicana*. ♂. Dallas, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 22.—*Mermiria neo-mexicana*. ♀. Havana, Illinois. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 23.—*Mermiria neo-mexicana*. ♀. Dallas, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 24.—*Mermiria neo-mexicana*. ♀. Dallas, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 25.—*Mermiria neo-mexicana*. ♂. Syracuse, Kansas. Dorsal view of pronotum. ( $\times 3$ .)
- Fig. 26.—*Mermiria neo-mexicana*. ♀. Dallas, Texas. Dorsal view of pronotum. ( $\times 3$ .)
- Fig. 27.—*Mermiria neo-mexicana*. ♂. Baboquivari Mountains, Arizona. Lateral view of apex of abdomen. (Greatly enlarged.)
- Fig. 28.—*Mermiria alacris*. ♀. Pensacola, Florida. Lateral view. ( $\times 1\frac{1}{2}$ .)
- Fig. 29.—*Mermiria alacris*. ♂. Pensacola, Florida. Lateral view of head and pronotum. ( $\times 3$ .)
- Fig. 30.—*Mermiria alacris*. ♂. Bainbridge, Georgia. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 31.—*Mermiria alacris*. ♂. Bainbridge, Georgia. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 32.—*Mermiria alacris*. ♂. Dallas, Texas. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 33.—*Mermiria alacris*. ♂. Dallas, Texas. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 34.—*Mermiria alacris*. ♂. Pensacola, Florida. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 35.—*Mermiria alacris*. ♂. Waurika, Oklahoma. Dorsal view of fastigium. (Greatly enlarged.)

PLATE VI.—Fig. 1.—*Mermiria alacris*. ♀. Pensacola, Florida. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 2.—*Mermiria alacris*. ♂. Bainbridge, Georgia. Dorsal view of pronotum. (×3.)

Fig. 3.—*Mermiria alacris*. ♀. Pensacola, Florida. Dorsal view of pronotum. (×3.)

Fig. 4.—*Mermiria alacris*. ♂. Bainbridge, Georgia. Lateral view of apex of abdomen. (Greatly enlarged.)

Fig. 5.—*Mermiria intertexta*. ♀. Tybee Island, Georgia. Lateral view. (×1½.)

Fig. 6.—*Mermiria intertexta*. ♂. Tybee Island, Georgia. Lateral view of head and pronotum. (×3.)

Fig. 7.—*Mermiria intertexta*. ♂. Tybee Island, Georgia. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 8.—*Mermiria intertexta*. ♂. Tybee Island, Georgia. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 9.—*Mermiria intertexta*. ♂. Atlantic Beach, Florida. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 10.—*Mermiria intertexta*. ♂. Atlantic Beach, Florida. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 11.—*Mermiria intertexta*. ♀. Tybee Island, Georgia. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 12.—*Mermiria intertexta*. ♂. Tybee Island, Georgia. Dorsal view of pronotum. (×3.)

Fig. 13.—*Mermiria intertexta*. ♀. Tybee Island, Georgia. Dorsal view of pronotum. (×3.)

Fig. 14.—*Mermiria intertexta*. ♂. Tybee Island, Georgia. Lateral view of apex of abdomen. (Greatly enlarged.)

Fig. 15.—*Mermiria bivittata*. ♀. Flatonia, Texas. Lateral view. (×1½.)

Fig. 16.—*Mermiria bivittata*. ♂. Flatonia, Texas. Lateral view of head and pronotum. (×3.)

Fig. 17.—*Mermiria bivittata*. ♂. Flatonia, Texas. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 18.—*Mermiria bivittata*. ♂. Flatonia, Texas. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 19.—*Mermiria bivittata*. ♀. Navasota, Texas. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 20.—*Mermiria bivittata*. ♀. Navasota, Texas. Dorsal view of fastigium. (Greatly enlarged.)

Fig. 21.—*Mermiria bivittata*. ♂. Flatonia, Texas. Dorsal view of pronotum. (×3.)

Fig. 22.—*Mermiria bivittata*. ♀. Flatonia, Texas. Dorsal view of pronotum. (×3.)

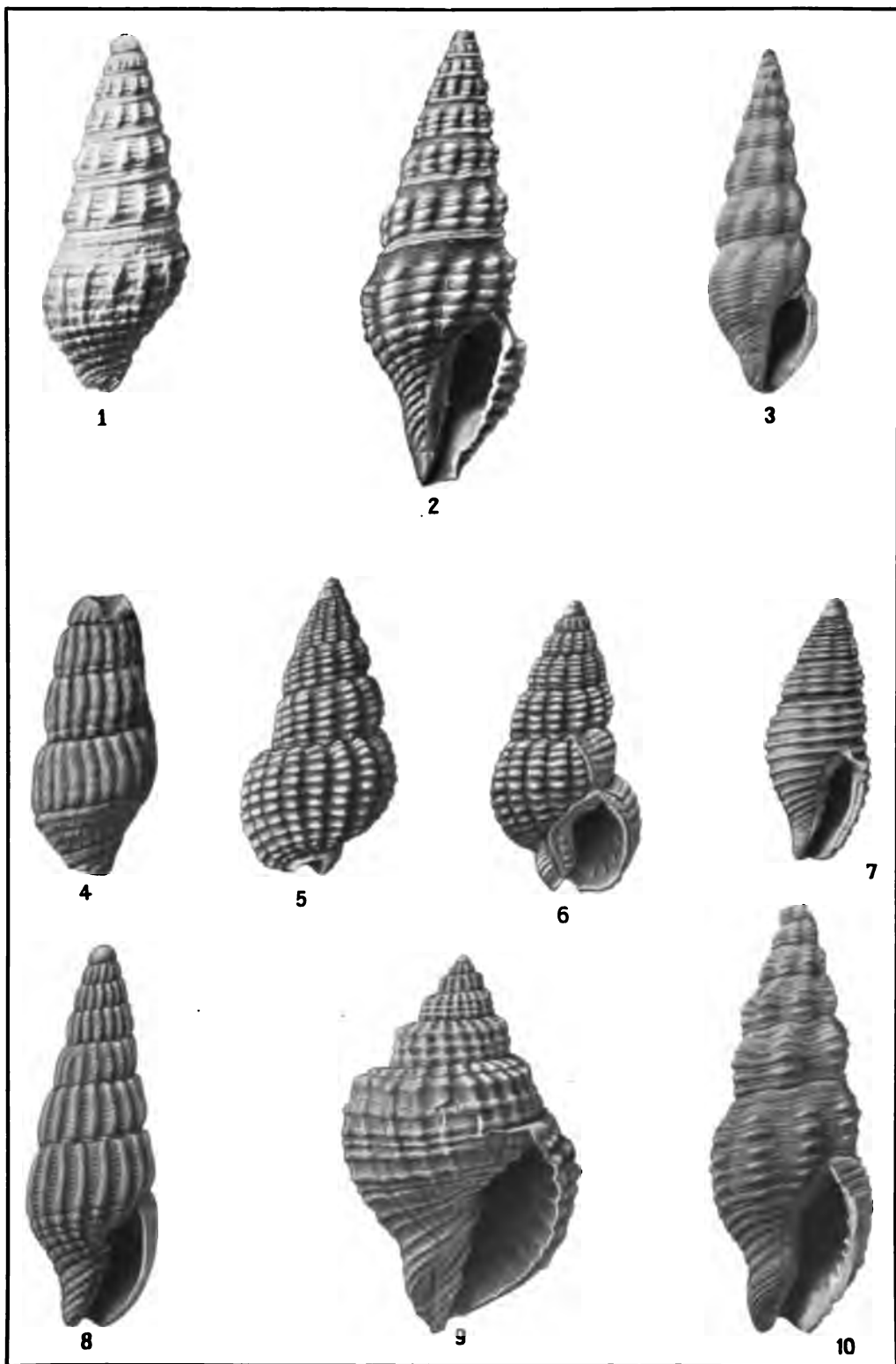
Fig. 23.—*Mermiria bivittata*. ♂. Flatonia, Texas. Lateral view of apex of abdomen. (Greatly enlarged.)

Fig. 24.—*Mermiria bivittata*. ♂. Flatonia, Texas. Lateral view of tegmen. (×2.)

Fig. 25.—*Mermiria maculipennis maculipennis*. ♀. Lyford, Texas. Lateral view. (×1½.)

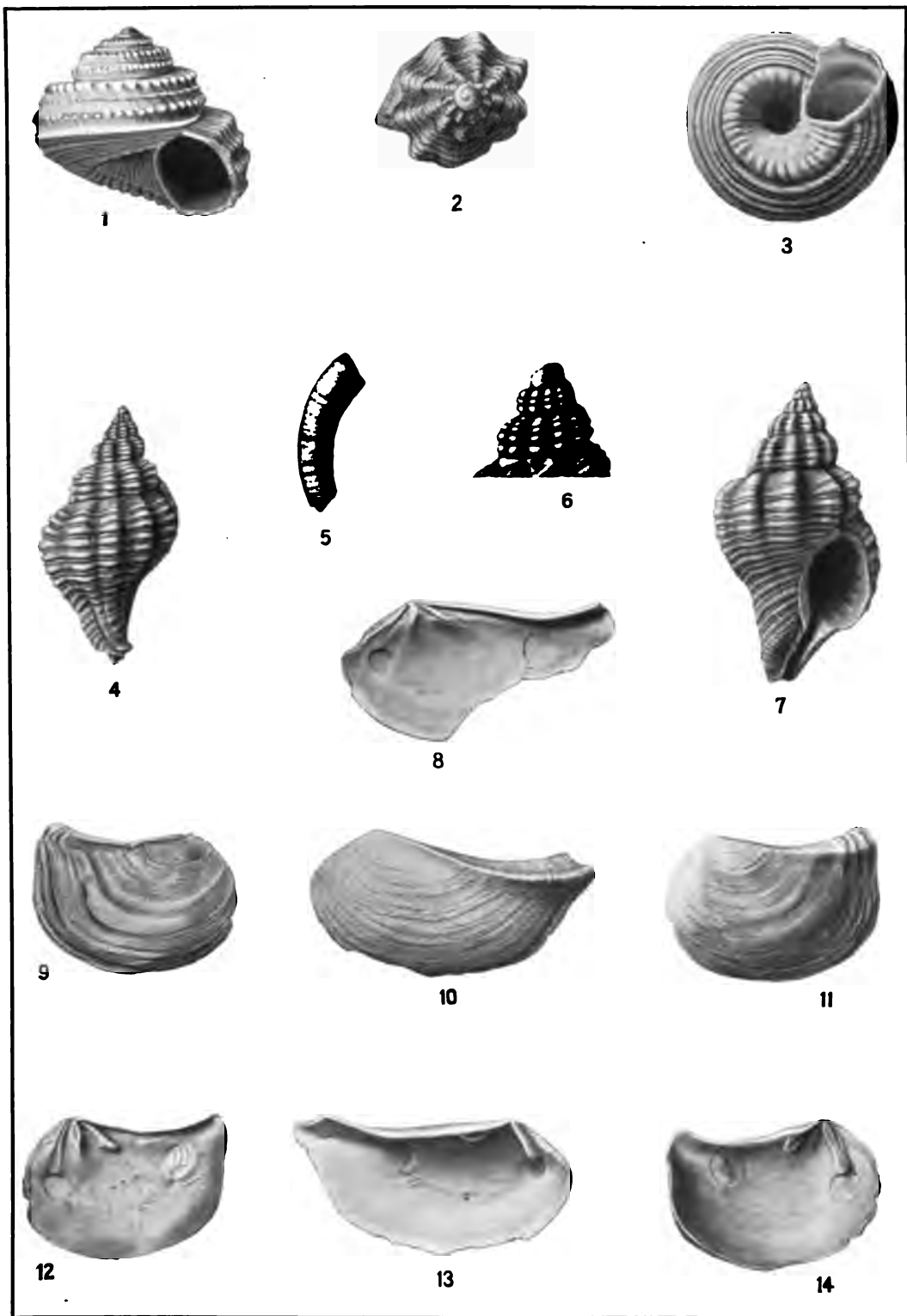
Fig. 26.—*Mermiria maculipennis maculipennis*. ♂. Benevides, Texas. Lateral view of head and pronotum. (×1½.)

- PLATE VII.—Fig. 1.—*Mermiria maculipennis maculipennis*. ♂. El Paso, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 2.—*Mermiria maculipennis maculipennis*. ♂. El Paso, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 3.—*Mermiria maculipennis maculipennis*. ♂. Benevides, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 4.—*Mermiria maculipennis maculipennis*. ♂. Benevides, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 5.—*Mermiria maculipennis maculipennis*. ♂. Dallas, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 6.—*Mermiria maculipennis maculipennis*. ♂. Dallas, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 7.—*Mermiria neo-mexicana*. ♀. Sycamore Canyon, Baboquivari Mountains, Arizona. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 8.—*Mermiria maculipennis maculipennis*. ♀. El Paso, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 9.—*Mermiria maculipennis maculipennis*. ♀. Sycamore Canyon, Baboquivari Mountains, Arizona. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 10.—*Mermiria maculipennis maculipennis*. ♀. Katherine, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 11.—*Mermiria maculipennis maculipennis*. ♀. Katherine, Texas. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 12.—*Mermiria maculipennis maculipennis*. ♂. Benevides, Texas. Dorsal view of pronotum. (×3.)
- Fig. 13.—*Mermiria maculipennis maculipennis*. ♀. Katherine, Texas. Dorsal view of pronotum. (×3.)
- Fig. 14.—*Mermiria maculipennis maculipennis*. ♂. Benevides, Texas. Lateral view of apex of abdomen. (Greatly enlarged.)
- Fig. 15.—*Mermiria maculipennis macclungi*. ♂ (*type*.) Forsyth, Montana. Lateral view. (×3.)
- Fig. 16.—*Mermiria maculipennis macclungi*. ♂ (*paratype*.) Forsyth, Montana. Lateral view of apex of abdomen. (Greatly enlarged.)
- Fig. 17.—*Mermiria maculipennis macclungi*. ♂ (*type*.) Forsyth, Montana. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 18.—*Mermiria maculipennis macclungi*. ♂ (*paratype*.) Forsyth, Montana. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 19.—*Mermiria maculipennis macclungi*. ♂. North Platte, Nebraska. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 20.—*Mermiria maculipennis macclungi*. ♂. North Platte, Nebraska. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 21.—*Mermiria maculipennis macclungi*. ♀ (*allotype*.) Forsyth, Montana. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 22.—*Mermiria maculipennis macclungi*. ♀. Kearney, Nebraska. Dorsal view of fastigium. (Greatly enlarged.)
- Fig. 23.—*Mermiria macclungi*. ♀ (*allotype*.) Forsyth, Montana. Dorsal view of pronotum. (×3.)
- Fig. 24.—*Mermiria maculipennis macclungi*. ♀. Kearney, Nebraska. Dorsal view of pronotum. (×3.)



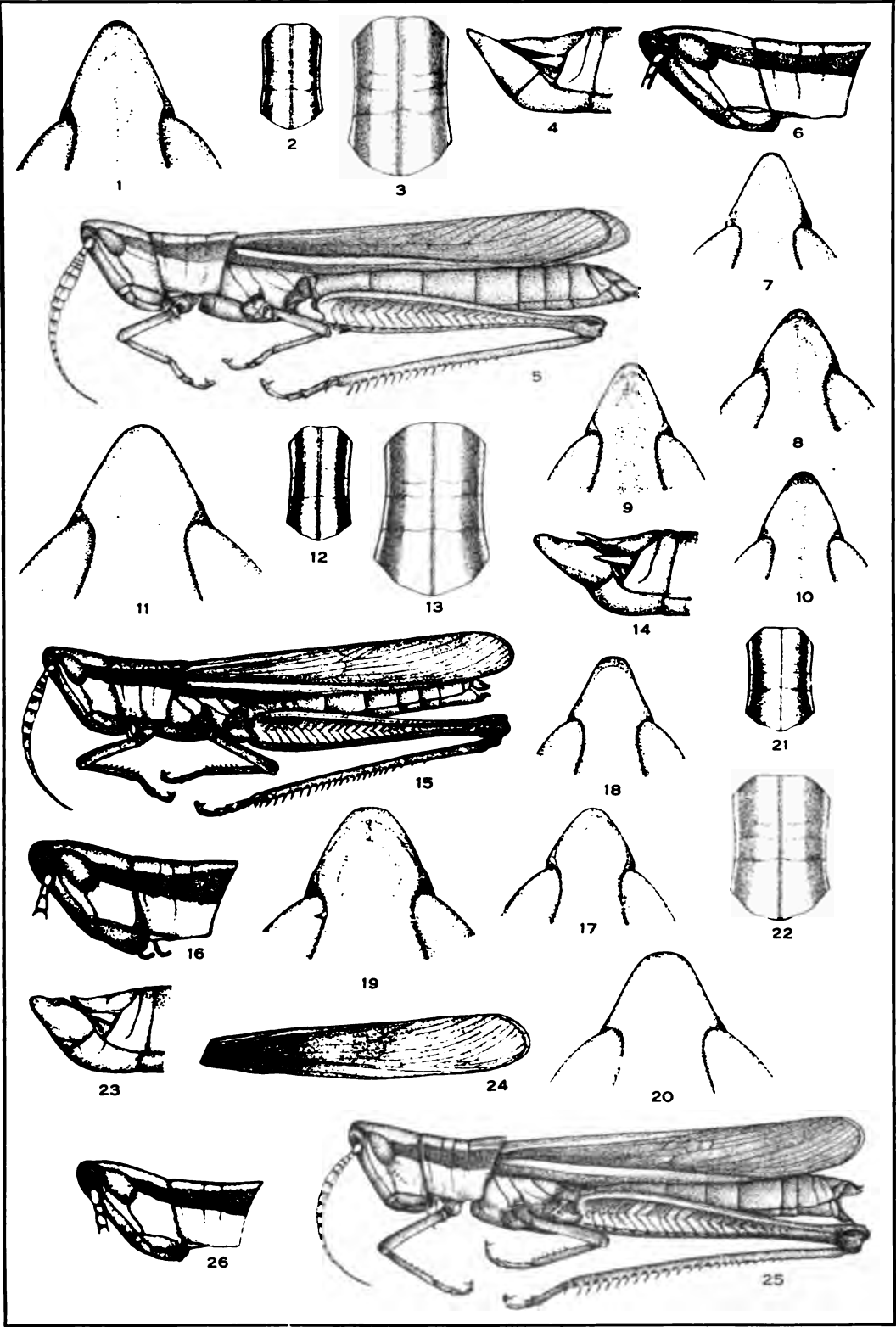
GARDNER AND ALDRICH: MIOCENE MOLLUSCA.











REHN: GENUS MERMIRIA.



April 15.

The President, JOHN CADWALADER, A.M., LL.D., in the Chair.

Forty persons present.

The deaths of David Jayne Bullock, a member, March 19, 1919, and Frederick D. Godman, a correspondent, February 19, 1919.

DR. JOHN W. HARSHBERGER made a communication on "Slope Exposure and the Distribution of Plants in Eastern Pennsylvania." (No abstract.)

Edgar Fahs Smith, Ph.D., LL.D., was elected a member.

The following were ordered to be printed:

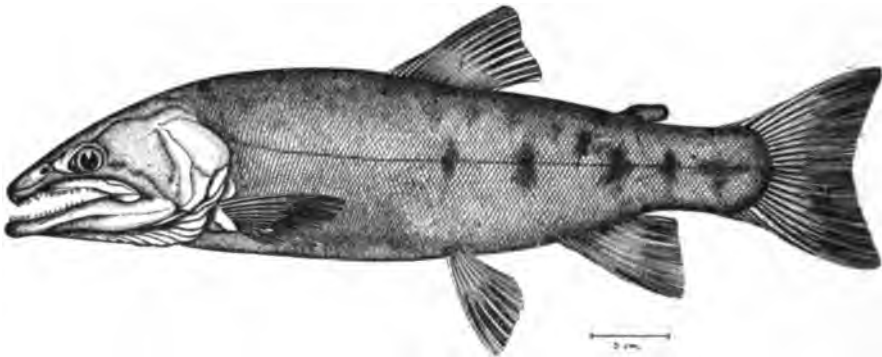
**SALMO FORMOSANUS, A NEW TROUT FROM THE MOUNTAIN STREAMS  
OF FORMOSA**

BY DAVID STARR JORDAN AND MASAMITSU OSHIMA.

In a mountain stream of Central Formosa, the junior author, as governmental fishery expert for the Island of Formosa, made the unexpected discovery of a large species of trout, which seems to be new to science. The accompanying figure is drawn by Mr. Oshima.

*Salmo formosanus* Jordan and Oshima.

Head  $3\frac{1}{2}$  in length to base of caudal; depth 4; D. III, 11; A. III, 10; P. 12; V. 9; snout  $3\frac{1}{2}$  in head; eye 6; interorbital space  $3\frac{1}{2}$ ; maxillary  $2\frac{1}{4}$ ; pectoral  $1\frac{1}{2}$ ; ventral 2; anal  $1\frac{1}{2}$ ; scales in lateral series about 130 (oblique rows) in transverse series 26-22; branchiostegals 13; gillrakers on first arch 7+9.



*Salmo formosanus* Jordan and Oshima.

Body rather deep, moderately elongate, compressed, dorsal profile more strongly curved than that of the ventral; head large, the jaws produced (male example), interorbital space broad, nearly flat; maxillary reaching far beyond the eye; snout pointed; mouth large, slightly oblique, upper jaw shorter than the lower; eye large, anterior; nostrils close together, in front of the eye; vomer nearly flat, the shaft much depressed, the head of the bone with six teeth, the shaft with eleven teeth which are set in a zigzag series, those on

the shaft placed directly on the surface of the bone, not on a free crest; tongue with five pairs of canine-like teeth; premaxillary with eight, maxillary with twenty-five, dentary with sixteen, palatine with eighteen teeth; operculum smooth; branchiostegals well developed; gillrakers rather slender and long.

Dorsal fin inserted midway between the tip of snout and the base of caudal, the longest ray  $1\frac{1}{2}$  in head; adipose dorsal nearer to the caudal than to the dorsal; caudal peduncle strongly compressed, its depth  $2\frac{1}{2}$  in head; ventral inserted below the 7th branched ray of the dorsal; anal rather high, straight-edged, entirely behind the dorsal, the longest ray 2 in head, longer than the base of the fin.

Body covered with small firm scales; lateral line nearly straight, running along the middle of the side, slightly upcurved in front.

Color (in formalin) brownish gray above, belly and lower parts of the sides whitish; small dark spots scattered along both sides of the dorsal median line, none distinct on head, nor along the base of dorsal; sides with traces of large blackish bars; bases of all the fins except caudal dusky, outer margin of the fins dark; caudal fin uniformly dark; head and inner part of the mouth fuscous. Total length 335 mm.

Described from a specimen from Taiko River at Saramao, Nanto, Formosa.

Saramao is located in the middle part of the Island of Formosa just on the summit of the central mountain range. Until now there was no record in Formosa with regard to the occurrence of salmon or trout, even in the mid stream or estuary of Taiko River. It is said, however, that the aborigines who live in the vicinity of Saramao occasionally catch a trout-like fish which they value as food. By the courtesy of Mr. Tomomatsu Tsusaki, policeman at Shikikun, Mr. Oshima has received the present specimen of the species. According to his statement, it was caught by a native and was forwarded to the Police Station at Shikikun in October, 1918.

As the method of preservation was not satisfactory, almost all the markings had disappeared when the specimen was received. There is no doubt that it was actually taken in Formosa, because of the presence of red spots on the back which vanished gradually and of the fresh state of the specimen when it was forwarded to the Government Institute of Science in Taihoku.

The typical specimen is preserved in the Museum of the Institute of Science of the Government of Formosa.

*Salmo formosanus* belongs to the subgenus *Trutta* L., including the river trout. Two forms related to it have been described by Bleeker from China, the exact locality not known; these are *Salmo leptosoma* and *Salmo pomatops* Bleeker in his paper, "Sur quelques espèces inédites on peu connus de poissons de Chine appartenant au Muséum de Hambourg." *Verh. Akad. Amsterdam*, XVIII, 187a, pp. 14, 15.

All their species are also more or less closely related to the European brook trout (*Salmo trutta* = *S. fario*). *Salmo leptosoma* has perhaps a slenderer body than *S. saramao*, and *Salmo pomatops* has a black spot or ocellus on the opercle.

**A NEW SILUROID FISH OF THE GENUS CYCLOPIUM FROM COLOMBIA**

BY HENRY W. FOWLER

***Cyclopium mariae* new species.**

Head  $4\frac{1}{2}$ ; depth  $6\frac{1}{4}$ ; D. I, 6; A. I, 6; P. I, 10; V. I, 4; snout  $1\frac{1}{2}$  in head; mouth width  $2\frac{1}{2}$ ; interorbital  $5\frac{1}{4}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; caudal 1; pectoral 1; ventral  $1\frac{1}{6}$ .

Body elongate, rather slender in profile, broadly depressed anteriorly, deepest at dorsal origin. Caudal peduncle well compressed, elongate, or least depth about  $1\frac{1}{4}$  its length.

Head broadly depressed, width about 3 times that of body at dorsal origin, rather convex above and flattened below. Snout broad, surface slightly convex, and as seen from above nearly twice as broad as long. Eyes very small, superior entirely, front edge about midway in head length, without distinct eyelids. Mouth broad, slightly crescentic, and end of mandible about first fifth in snout length. Buccal disk wide, that of lower jaw 3 times as wide as upper, its hind edge with slight median emargination, and surface rather coarsely papillose. Lateral barbel begins about midway in snout length, and extends back nearly to gill-opening. About 8 simple conic, rather large teeth each side of upper jaw, and inside forming rather broad band 3 or 4 rows of similarly large bifid teeth. Lower jaw with 3 rows of bifid teeth, about 6 along outer edge of each mandibular ramus, and innermost row of much smaller bifid teeth or about 12 on each ramus. Nostrils about wide apart as eye, rather large simple pores and each with broad cutaneous fold behind. Both internasal and interorbital spaces level. Each cheek with swollen appearance below eye.

Gill-opening lateral, scarcely extends below pectoral base and forward only about half way in postocular. A simple or rudimentary little gill-raker on first arch and only about 4 short simple points or tubercles on second and third arches, and six on last arch. Gill-filaments about twice eye diameter.

Enlarged rays of fins all with very small denticles on their outer surfaces or edges. Basal portions of upper faces of pectoral rays with spinules. Upper surface of head and predorsal with very small and slightly scattered papillæ, which become more minute and crowded at dorsal base and finally obsoletely minute on rest of trunk.



Dorsal origin nearly midway between snout tip and hind anal ray base, and flexible spine largest of rays, depressed fin short or but slightly longer than predorsal space to head. Adipose fin obsolete, only evident as slight ridge along upper edge of caudal peduncle behind anal base. Anal inserted slightly nearer caudal base than ventral origin, median rays longest, or fin extends about half way to caudal base. Caudal emarginate behind, uppermost and lowermost simple rays longest, forming sharp points. Pectoral low, outermost or simple enlarged ray much longest, reaching base of uppermost ventral ray. Ventral inserted about opposite dorsal origin, fin long and slender or  $1\frac{1}{2}$  to anal. Anal papilla long, slender, conic, about  $\frac{2}{3}$  of anal spine.

Color in alcohol dull brownish generally, with more or less clouded or dull slaty marblings. Under surface of head, breast and belly pale brownish-white, also lower surfaces of fins pale. Iris pale slaty. Pectorals and ventrals with obscure shades of dusky on rays basally, also same tints on dorsal and caudal rays.

Length 95 mm.

Type, No. 49,368, A. N. S. P. ♂. Brook near the small village of Choachi, 25 kilometers east of Bogota and at 1800 meters of altitude, Colombia, 1917. Hermano Apolinar Maria.

Also Nos. 49,369 to 49,384, A. N. S. P., paratypes, with same data, of which seven are females. All show: Head  $3\frac{1}{2}$  to  $4\frac{1}{2}$ ; depth  $5\frac{1}{2}$  to  $7\frac{1}{2}$ ; D. I, 6; A. I, 6; head width 1 to  $1\frac{1}{2}$  in its length; snout  $1\frac{1}{2}$  to 2; mouth width  $2\frac{1}{4}$  to 3; interorbital 3 to  $4\frac{1}{2}$ ; length 40 to 88 mm. In the males the dorsal spines are damaged, opercle spiny, barbel reaches pectoral origin, caudal much longer than head and no adipose spine. The young show a dark caudal base. The females are variable in depth, often with the adipose ridge of the back better developed than in the male. They have the head about equally papillose and spinescent, though are without the anal papilla.

A male which was dissected had the remains of large dipterous insect larva in its pharynx.

This species appears allied with *C. ventrale* Eigenmann<sup>1</sup> from Dagua, which it represents in the headwater drainage of the Rio Meta basin. *C. ventrale* appears to differ in the presence of an adipose spine, nasal barblet and in having the ventrals reaching slightly beyond the vent. Other Colombian species, *C. chapmani* Eigenmann,<sup>2</sup> *C. trifasciatum* Eigenmann<sup>3</sup> and *C. unifasciatum* Eigenmann<sup>4</sup>

<sup>1</sup> Indiana Univ. Bull., X, No. 8, September, 1912, p. 15.

<sup>2</sup> L. c., p. 13. Boquia.

<sup>3</sup> L. c., p. 14. Caldas and Cisneros.

<sup>4</sup> L. c., p. 15. Caldas.

are excluded on account of their more anterior ventrals, in all of which they are said to be distinctly before the dorsal origin.

(For Hermano Apolinar Maria, of the Instituto de La Salle, Bogota, to whom I am indebted for the opportunity to study this interesting prenadilla.)

#### EXPLANATION OF PLATE VIII.

Uppermost figure, male; upper figure to left, dorsal view of head (male); upper figure to right, ventral view of head (male); median figure, young; lowest figure, female.

## NOTES ON TROPICAL AMERICAN FISHES

BY HENRY W. FOWLER

While studying certain groups of marine fishes in the museum of the Academy I have recently had occasion to examine several old collections which have never been reported. Some include a few types of Cope, of which additional notes and diagnoses are given below. This has been attempted as most all his originals are too brief and lack many of the details demanded by modern standards. The material representing Cope's "Ichthyology of the Lesser Antilles" is largely extant, and is also included. Material from the Bahamas and Jamaica, sent to the University of Pennsylvania, and now in its Zoological Laboratory, was kindly placed at my disposal by Dr. J. Percy Moore.

## PANAMA.

A small collection received from Dr. W. S. W. Ruschenberger in 1857, another from Captain Field in 1862, and later some small examples from J. A. McNiel. All from Panama City.

- |   |  |
|---|--|
| 1. <i>Sphyrna zygaena</i> Linné.              | 17. <i>Epinephelus labriformis</i> (Jenyns).   |
| 2. <i>Rhinobatos leucorhynchus</i> Günther.   | ( <i>E. ordinatus</i> Cope, Trans. Amer.       |
| 3. <i>Urotrygon mundus</i> Gill.              | Philos. Soc. Phila., XIV, 1871,                |
| 4. <i>Cetengraulis engyumen</i> Gilbert and   | p. 466.)                                       |
| Pierson.                                      | 18. <i>Rypticus xanti</i> Gill.                |
| 5. <i>Dorosoma pelenensis</i> (Günther).      | 19. <i>Anisotremus tæniatus</i> Gill.          |
| 6. <i>Myrophis vafer</i> Jordan and Gilbert.  | 20. <i>Brachydeuterus leusiccus</i> (Günther). |
| 7. <i>Rabula panamensis</i> (Steindachner).   | 21. <i>Polydactylus opercularis</i> (Gill).    |
| 8. <i>Muraena clepsydra</i> Jordan and        | 22. <i>Pomacentrus rectifrons</i> Gill.        |
| Evermann.                                     | 23. <i>Chaetodipterus zonatus</i> (Girard).    |
| 9. <i>Bagre pinnimaculata</i> (Steindach-     | 24. <i>Canthigaster punctatissimus</i> (Gün-   |
| ner).   | ther).   |
| 10. <i>Mollienisia sphenops</i> (Valen-       | 25. <i>Diodon hystrix</i> Linné.               |
| ciennes).                                     | 26. <i>Prionotus horrens</i> Richardson.       |
| 11. <i>Fodiator acutus</i> (Valenciennes).    | 27. <i>Leptecheneis naucrates</i> (Linné).     |
| 12. <i>Hemiramphus saltator</i> Gilbert and   | 28. <i>Batrachoides pacifici</i> (Günther).    |
| Starks.                                       | 29. <i>Auchenopterus monophthalmus</i>         |
| 13. <i>Hippocampus ingens</i> Girard.         | (Günther).                                     |
| 14. <i>Sphyræna ensis</i> Jordan and Gilbert. | 30. <i>Hypsoblennius striatus</i> (Steindach-  |
| 15. <i>Vomer setapinnis</i> (Mitchill).       | ner).  |
| 16. <i>Amia retiosella</i> Gill.              |  |

An old saw from Captain Field is doubtless *Pristis zephyreus* (Jordan and Starks), but without other characters is not certain.

<sup>1</sup> Trans. Amer. Philos. Soc. Phila., (new series) XIV, 1871, pp. 445-483.

## RIO DE JANEIRO, BRAZIL

Dr. Ruschenberger, with Dr. Thomas J. Turner, made a small collection of the market fishes, received in 1854. A few examples were also obtained from William Hyde and E. D. Cope, and some presented by the Museum of Comparative Zoology at Cambridge, at a later date.

1. *Elops saurus* Linné.
2. *Clupanodon pseudohispanicus* (Poey).
3. *Harengula pensacolæ* Goode.
4. *Opisthonema oglinum* (Le Sueur).
5. *Anchovia brownii* (Gmelin).
6. *Ctenogobius edentulus* (Cuvier).
7. *Netuma barbatus* (Lacépède).
8. *Fistularia tabacaria* Linné.
9. *Holocentrus ascensionis* (Osbeck).
10. *Trichiurus lepturus* Linné.
11. *Oligoplites saliens* (Bloch).
12. *Alepes amblyrhynchus* (Cuvier).
13. *Caranx hippos* Linné.
14. *C. latus* Agassiz.
15. *Vomer setapinnis* (Mitchill).
16. *Chloroscombrus chrysurus* (Linné).
17. *Seserinus xanthurus* Quoy and Gaimard.
18. *Centropomus constantinus* Jordan and Evermann.
19. *Epinephelus guaza mentzelii* (Valenciennes).  
(*E. brachysoma* Cope, Trans. Amer. Philos. Soc. Phila., XIV, 1871, p. 466.)
20. *Diplectrum formosum* (Linné).
21. *Priacanthus arenatus* Cuvier.
22. *P. cruentatus* (Lacépède).
23. *Lutjanus analis* (Cuvier).
24. *Orthopristis ruber* (Cuvier).
25. *Archosargus unimaculatus* (Bloch).
26. *Eucinostomus pseudogula* Poey.
27. *Gerres rhombeus* Cuvier.
28. *Micropogon opercularis* (Quoy and Gaimard).
29. *Geophagus brasiliensis* (Quoy and Gaimard).
30. *Halichæres poeyi* (Steindachner).
31. *Bodianus rufus* (Linné).
32. *Cryptotomus ustus* (Valenciennes).
33. *Chelodipterus faber* (Broussonet).
34. *Holacanthus tricolor* (Bloch).
35. *Balistes vetula* Linné.
36. *Stephanolepis hispidus* (Linné).
37. *Lactophrys triqueter* (Linné).
38. *Spheroides spengleri* (Bloch).
39. *Dactylopterus volitans* (Linné).
40. *Antennarius scaber* (Cuvier).

## SURINAM, DUTCH GUIANA.

Dr. Constantine Hering made a very interesting collection at this locality, which was received at the Academy about 1830. A few fishes obtained by Dr. William Keller in 1856 I have not located.

1. *Eulamia oxyrhynchus* (Müller and Henle).
2. *Sphyrna tudes* (Valenciennes).
3. *S. zygaena* (Linné).
4. *Pristis perotteti* Müller and Henle.
5. *Elops saurus* Linne.
6. *Heringia amazonica* (Steindachner).
7. *Odonotnathus mucronatus* Lacépède.
8. *Anchovia lepidentostole* Fowler.  
(Proc. Acad. Nat. Sci. Phila., 1911, p. 214, fig. 3.)
9. *Pterengraulis atherinoides* (Linné).
10. *Lycengraulis grossidens* (Agassiz).
11. *Synbranchus marmoratus* Bloch.
12. *Selenaspis herzbergii* (Bloch).
13. *Netuma aulometopon* Fowler.  
(L. c., 1915, p. 204, fig. 1.)
14. *Rhamdia seba* (Valenciennes).
15. *Brachyplatystoma vaillantii* (Valenciennes).
16. *Pseudoplatystoma fasciatum* (Linné).
17. *Doras granulosus* Valenciennes.
18. *D. cataphractus* (Linne).
19. *Trachycorystes galeatus* (Linné).
20. *Pseudauchenipterus nodosus* (Bloch).
21. *Ageneiosus porphyreus* Cope.  
(Trans. Amer. Philos. Soc. Phila., XIII, 1867, p. 404.)

Head  $3\frac{1}{2}$ ; depth 5; D. I, 7; A. iv, 41; head width  $1\frac{1}{2}$  its length; snout  $2\frac{1}{2}$ ; eye  $7\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ ; mouth width  $2\frac{1}{2}$ ; dorsal height 2; pectoral  $1\frac{1}{2}$ ; ventral 2; least depth of caudal peduncle  $3\frac{1}{2}$ ; upper caudal lobe  $1\frac{1}{2}$ . Body greatly compressed, upper profile straight, lower convex. Caudal peduncle about long as deep. Head wide, greatly depressed, depth over eye half its width. Snout greatly depressed, broadly spatulate, length about  $\frac{1}{2}$  its width. Eyes lateral, though more inferior, almost covered by adipose-eyelid, midway in head length. Mouth broad, gape about  $\frac{1}{2}$  to eye. Upper jaw produced well beyond lower, its teeth broadly exposed. Mouth roof smooth. Upper buccal fold very broad. Tongue wide, thick, fleshy, not free. Fine concealed maxillary barbel about  $\frac{1}{2}$  of eye. Front nostril about first  $\frac{1}{2}$  in snout. Hind nostril about midway between snout tip and hind eye edge. Interorbital convex, with long median fontanel which broader anteriorly and not extended back to occipital process. Rakers III 3+4 x, short, lanceolate, about  $\frac{1}{2}$  of filaments, which nearly long as eye. Body everywhere with smooth skin. Spinous dorsal inserted close behind head or little nearer anal origin than snout tip, fin base about  $\frac{1}{2}$  its height. Adipose fin inserted about last third between depressed spinous dorsal tip and caudal base, fin equals  $1\frac{1}{2}$  eye-diameters. Anal origin midway between hind eye edge and caudal base, fin long and low, slightly higher anteriorly. Caudal well forked, pointed lobes about equal. Pectoral low, reaches  $\frac{1}{2}$  to ventral. Ventral origin at last  $\frac{1}{2}$  between pectoral and anal origins, reaches anal. Vent close before anal. Color in alcohol largely dull brownish, paler below. Head above and back with obscure slaty or darker marblings. Fins pale brownish. Length 280 mm. Cotype (type) No. 8389, A. N. S. P.

Also another cotype: Head  $3\frac{1}{2}$ ; depth  $5\frac{1}{2}$ ; D. I, 5; A. iv, 41; snout  $2\frac{1}{2}$  in head; eye  $7\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital 2; length 178 mm. (caudal tips damaged).

- |  |  |
|--|--|
| 22. <i>Platystacus cotylephorus</i> Bloch.   | 33. <i>Gasteropelecus sternicla</i> (Linné). |
| 23. <i>Aspredo aspredo</i> (Linné).          | 34. <i>Charax gibbosus</i> (Linné).          |
| 24. <i>Callichthys callichthys</i> (Linné).  | 35. <i>Hoplias malabaricus</i> (Bloch).      |
| 25. <i>Plecostomus plecostomus</i> (Linné).  | 36. <i>Erythrinus unitaeniatus</i> Agassiz.  |
| 26. <i>Loricariichthys typus</i> (Bleeker).  | 37. <i>Gymnotus carapo</i> Linné.            |
| 27. <i>Loricaria cataphracta</i> Linné.      | 38. <i>Sternopygus macrurus</i> (Schneider). |
| 28. <i>Curimata copei</i> Fowler.            | 39. <i>Anableps anableps</i> (Linné).        |
| (Proc. Acad. Nat. Sci. Phila.,               | 40. <i>Pacilia vivipara</i> Schneider.       |
| 1906, p. 301, fig. 7.)                       | 41. <i>Mugil incilis</i> Hancock.            |
| 29. <i>C. schomburgkii</i> (Günther).        | 42. <i>Trichiurus lepturus</i> Linné.        |
| 30. <i>Curimatella alburnus</i> (Müller and  | 43. <i>Caranx latus</i> Agassiz.             |
| Troschel).                                   | 44. <i>Selene vomer</i> (Linné).             |
| 31. <i>Astyanax caucanus</i> (Steindachner). | 45. <i>Centropomus pectinatus</i> Poey.      |
| 32. <i>A. bimaculatus</i> (Linné).           |  |

46. *C. parallelus* Poey.  
(*C. heringi* Fowler, l. c., 1906,  
p. 423, fig. 2.)
47. *C. undecimalis* (Bloch).
48. *Anisotremus surinamensis* (Bloch).
49. *Cynoscion acoupa* (Lacépède).
50. *Nebrius microps* Cuvier.
51. *Plagioscion squamosissimus* (Heckel).
52. *Plagioscion monacanthus* (Cope).  
(*Corvina monacantha* Cope, Trans. Amer. Philos. Soc. Phila., (2) XIII, 1866,  
p. 402.)

Head  $3\frac{1}{4}$ ; depth  $3\frac{1}{4}$ ; D. X, I, 33; A. II, 6; pores (enlarged scales) in l. l. to caudal base 50; 11 scales above l. l. to soft dorsal origin, 10 below to spinous anal origin; head width 2 in its length; snout 4; eye  $6\frac{2}{3}$ ; maxillary 2; interorbital  $3\frac{1}{4}$ ; third dorsal spine  $2\frac{2}{3}$ ; second anal spine 2; least depth of caudal peduncle  $3\frac{1}{4}$ ; caudal  $1\frac{1}{4}$ ; pectoral  $1\frac{1}{4}$ ; ventral  $1\frac{1}{4}$ . Body well compressed, back elevated. Head deep, upper profile slightly concave above eye. Snout convex, length  $\frac{3}{4}$  its width. Eye center at first  $\frac{2}{3}$  in head. Mouth large, lower jaw slightly included. Maxillary reaches hind eye edge. Teeth in bands in jaws, fine, with outer row enlarged, upper little more so. Tongue free, smooth. Nostrils together, close before eye. Interorbital convex. Hind preopercle edge entire, except 2 short points at angle below. Rakers II 4+10 v, lanceolate,  $1\frac{1}{2}$  in eye or longer than filaments. Scales finely ctenoid, in oblique rows on trunk. Large scales on opercle and few behind eye. Of head only lips naked. L. l. of enlarged scales concurrent with dorsal profile to anal, then midway or horizontal, and on caudal to its end. Dorsal spines thin, fourth longest. Soft dorsal inserted slightly nearer caudal base than snout tip, height about uniform. Anal inserted about midway between ventral origin and caudal base, first spine rudiment and second but little less than rays (damaged). Caudal ends in median point behind. Pectoral  $1\frac{1}{2}$  to anal. Ventral inserted opposite pectoral origin, first ray ends in filament, spine slightly less than half of fin. Vent well before anal, or at depressed ventral tip. Color in alcohol dull uniform brownish, with brassy and silvery reflections. Caudal and pectoral with three deep brown cross-bars. Length 213 mm. No. 11,519, A. N. S. P., type of *Corvina monacantha* Cope.

The above example has wrongly been referred to *Plagioscion squamosissimus* (Heckel) by Jordan and Eigenmann,<sup>2</sup> and allowed to repose in its synonymy ever since. It appears identical with *Pseudosciaena surinamensis* Bleeker,<sup>3</sup> which name it replaces. In the large anal spine it is allied with *Plagioscion auratus* (Castelnau).

<sup>1</sup> Rep. U. S. Fish Com., XIV, 1886 (1889), p. 382.

<sup>2</sup> Arch. Néerl. Sci. Nat. Harlem, VIII, 1873, p. 458, Pl. 21.

53. *Pachypops grunniens* (Schomburgk). 56. *Cichlasoma bimaculatum* (Linné).  
 54. *Ophioscion adustus* (Agassiz). 57. *Dactylopterus volitans* (Linné).  
 55. *Sagenichthys ancylodon* (Schneider). 58. *Dormilator maculatus* (Bloch).

59. *Eleotris amblyopsis* (Cope).

(*Culius amblyopsis* Cope, Trans. Amer. Philos. Soc. Phila., XIV, 1871, p. 473.)

Head  $2\frac{3}{4}$ ; depth  $3\frac{1}{4}$ ; D. VI—8, 1; A. I, 8, 1; scales 42 in median lateral series to caudal base and 6 more on latter; 14 scales transversely between soft dorsal and anal origins; about 38 ? predorsal scales; head width  $1\frac{1}{2}$  its length; third dorsal spine  $2\frac{3}{4}$ ; sixth dorsal ray  $1\frac{1}{2}$ ; seventh anal ray 2; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ ; snout  $4\frac{1}{2}$  in head measured from upper jaw tip; eye  $5\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{4}$ . Body well compressed, contour slenderly ellipsoid. Caudal peduncle strongly compressed, slightly longer than deep. Head robust, muzzle obtuse. Snout convex, length  $\frac{2}{3}$  its width. Eye small, elongate, center near first third in head. Mouth oblique, large, lower jaw well protruded. Maxillary reaches about center of eye. Teeth fine, in bands in jaws. Tongue broad, depressed, free. Interorbital slightly depressed in front, slightly convex. Preopercle with strong obscure spine, directed downwards. Rakers 6 low knob-like rudiments on lower limb of first arch. Head scaly, except muzzle. Scales small and crowded on predorsal. About 12 rows of fine scales across cheek. From lower eye edge 6 cutaneous ridges radiate down over infraorbital. On head, predorsal, breast and belly scales cycloid, on trunk ctenoid, and also larger on latter behind. Caudal and pectoral bases with small scales, fins otherwise naked. No trace of l. l. Dorsal spines thin, fin inserted slightly nearer snout tip than caudal base, third spine longest, reaches back slightly beyond soft dorsal origin. Last little nearer caudal base than hind preopercle edge, rays gradually higher towards last, not quite reaching caudal base. Anal opposite soft dorsal, similar. Caudal rounded, median rays longest. Pectoral broad, median rays longest, reaches vent. Ventral inserted slightly before pectoral origin, reaches  $\frac{3}{4}$  to anal, with small papilla. Color in alcohol dull uniform brownish generally. Dusky brown to blackish line from hind eye edge horizontally back to opercle above, two obliquely down from lower hind edge, and another more obscurely vertically down over infraorbital. Fins all finely barred with narrow dusky-brown lines. Black blotch, little smaller than pupil, just before pectoral origin. Iris slaty. Length 80 mm. (caudal tip damaged). Cotype (type) of *Culius amblyopsis* Cope, No. 10,577, A. N. S. P.

Also Nos. 10,578 and 10,579, A. N. S. P., cotypes, same data. These show: Head 3; depth 4 to  $4\frac{1}{2}$ ; D. VI—8, 1; A. I, 8, 1; scales 44 or 45 in median lateral series to caudal base and 6 or 7 more on latter; 16 scales transversely between soft dorsal and anal origins; 40 to 43 predorsal scales; snout  $4\frac{1}{2}$  to  $4\frac{3}{4}$  in head measured from upper jaw tip; eye  $5\frac{1}{2}$  to 6; maxillary  $2\frac{1}{2}$ ; interorbital 3 to  $3\frac{3}{8}$ ; length 80 mm.

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|---|--|
| 60. <i>Batrachoides surinamensis</i> (Schneider). | 62. <i>Achirus achirus</i> (Linné).          |
| 61. <i>Citharichthys spilopterus</i> Günther.     | 63. <i>A. lineatus</i> (Linné).              |
|   | 64. <i>Oncocephalus vespertilio</i> (Linné). |

#### ST. MARTIN'S ISLAND, WEST INDIES.

Dr. R. E. Van Rijgersma collected in the lower or Dutch portion of the island, likely largely at or about Phillipsburg. The collection was received at the Academy in 1869. This is the most important of Cope's collections embraced in his "Ichthyology of the Lesser Antilles," as it furnished the largest number of his new forms. Cope's account still appears to be the only one dealing with the fish-fauna of this island. Species mentioned by Cope, but which I fail to locate in the collection, are indicated by †. It long appeared clear that a great many specimens were never included in Cope's list, as I recorded some species since, and such as now remain are indicated by the prefixed asterisk. These indications are also applicable to the St. Croix and St. Christopher collections.

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|---|---|
| 1. <i>Ginglymostoma cirratum</i> (Bonaparte). | 5. <i>Anchovia platyargyrea</i> Fowler.               |
| 2. <i>Albula vulpes</i> (Linné).              | (Proc. Acad. Nat. Sci. Phila., 1911, p. 216, fig. 4.) |
| 3. <i>Harengula macrophthalma</i> (Ranzani).  | 6. <i>Anguilla rostrata</i> Le Sueur.                 |
| 4. <i>H. pensacola</i> Goode.                 | 7. <i>Myrichthys oculatus</i> (Kaup).                 |
8. *Enchelycore nigrocastaneus* (Cope).  
(*Gymnothorax nigrocastaneus* Cope, Trans. Amer. Philos. Soc. Phila., n. s. XIV, 1871, p. 483.)

Head 8; depth  $23\frac{1}{2}$ ; head width  $4\frac{1}{2}$  in its length; snout  $5\frac{1}{2}$  from upper jaw tip; eye  $9\frac{1}{2}$ ; upper jaw to rictus  $2\frac{1}{4}$ ; interorbital 9; head  $3\frac{1}{2}$  to vent. Body well compressed, also head, latter with flattened sides approximate below. Muzzle slender, acuminate. Snout conic, basal width  $1\frac{1}{2}$  its length. Eye slightly advanced. Mouth large, not closing, dentition well exposed. Teeth sharp-pointed, conic or moderately compressed, slightly inclined back. Upper teeth uniserial, erect, vary alternately small or little enlarged, latter but little longer than small lower teeth. Several enlarged erect upper canines at snout tip, another each side and one close before each eye. Inside and little advanced, though close to erect preocular pair of canines, another larger depressible canine each side. Between median and



pair of erect upper teeth at snout tip pair of depressible smaller conic teeth, one each side of median tooth and directed back. Close behind large front erect outer canine each side above 2 inner enlarged depressible conic teeth. Premaxillary teeth large canines, conic, depressible, first close behind median front erect upper tooth, second subequal and median about midway in snout length, last longest and median close before eye. Vomer with one row of low backwardly inclined compressed sharp-pointed teeth, smaller than lateral mandibulars or like smallest along upper jaw edges. Upper teeth begin about opposite eye center, close inside upper laterals inner row of 4 enlarged depressible conic teeth, last well behind eye. Lower teeth largely uniserial, compressed, sharp-pointed, inclined little back, all small except anterior. Pair of erect sharp conic symphyseal canines. In front of mandible each side anteriorly row of 3 enlarged depressible conic canines, first largest in jaw and second shorter than symphyseal pair, third about equal. Mandible elongate, slender, attenuate, protrudes little beyond upper, well curved, surface convex, rami low. Front nostril in short tube near snout tip, hind one long slit about  $\frac{3}{4}$  of eye. Interorbital convex. Gill-opening nearly horizontal, about midway in depth, about  $\frac{1}{2}$  of eye. Pharynx swollen, grooved below. Pores on head inconspicuous. Dorsal origin about opposite hind edge of gill-opening, like anal moderately high. Caudal  $2\frac{1}{2}$  in eye. Vent close before anal. Color in alcohol largely uniform chocolate-brown. At rictus color little darker, or dusky. Edge of gill-opening not noticeably darker. Iris slaty. Fins narrowly edged slightly darker than body-color. Length 610 mm. No. 16,032, A. N. S. P., type of *G. nigrocastaneus* Cope.

9. *Muraena miliaris* (Kaup).

(*Muraena myrialeucostictus* Fowler, Proc. Acad. Nat. Sci. Phila., 1912, p. 18, fig. 4.)

*Thyrsoidea miliaris* Kaup<sup>4</sup> is likely this species. He had a larger example, without locality, with "arabesque" figures towards end of tail, arising from the dots running into each other, which was 23.98 in. long. The other, from Martinique, appears to agree, though lack of details do not render this certain. *Muraena multiocellata* Poey<sup>5</sup> agrees largely in proportions, but it is said to have the lower teeth more serrated and numerous than the upper. Günther appears to have correctly placed Kaup's *T. miliaris* in *Muraena*,<sup>6</sup> though wrongly includes *Muraenopsis punctata* Castelnau,<sup>7</sup> as the latter is

<sup>4</sup> Cat. Apodal F. Brit. Mus., 1856, p. 90.

<sup>5</sup> Mém. Hist. Nat. Cuba, II, 1860, p. 324. Cuba.

shown with the dorsal origin about last fourth between mouth-corner and gill-opening. Cope appears the first to wrongly place it in *Gymnothorax*. Obviously in my own account the hind nostril is intended above the front eye edge in a short tube.

10. *Gymnothorax moringua* (Cuvier).

12. *Echidna catenata* (Bloch).

11. *G. carcinognathus* Fowler.

13. *Fundulus antillarum* Fowler.

(Proc. Acad. Nat. Sci. Phila.,  
1912, p. 22, fig. 5.)

(L. c., 1916, p. 418, fig. 1.)

\*14. *Belone argalus* Le Sueur.

Head  $2\frac{3}{4}$ ; depth  $21\frac{1}{4}$ ; D. II, 13; A. III, 17; scales 200 from shoulder to caudal base and 10 more on latter; 154 scales from occiput to dorsal origin; eye  $1\frac{1}{4}$  in postocular; interorbital 2; first branched dorsal ray  $1\frac{1}{2}$ ; caudal peduncle width  $2\frac{1}{2}$ , least depth  $4\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ ; postocular  $5\frac{1}{2}$  ? in rest of head; pectoral  $4\frac{1}{2}$  ?; lower caudal lobe 5; first branched anal ray  $4\frac{1}{2}$ . Body subcylindrical, caudal peduncle greatly depressed, with broad keel flaring out each side and continued back over caudal basally for  $\frac{2}{3}$ . Head large, with very long slender jaws, lower little longer. Eye large, next to upper profile. Maxillary entirely concealed, to front eye edge. Jaws not completely closing basally. Teeth very small. Interorbital broad, depressed, distinctly concave medially. Nasal cavity much smaller than pupil. Rakers 2+5, II, short weak points, about  $\frac{2}{3}$  of filaments, latter  $2\frac{1}{2}$  in eye. L. I. inferior, extends below keel along caudal peduncle side, but only to caudal base. Head largely scaly. Dorsal origin well behind anal origin, or slightly nearer ventral origin than caudal base, front lobes little elevated. Anal like dorsal, much larger and front lobe greatly longer. Hind caudal edge emarginate, lower lobe slightly longer. Pectoral pointed, reaches 4 to ventral and latter inserted about midway between hind eye edge and caudal base, fin  $2\frac{3}{4}$  to anal. Color in alcohol faded dull brownish above, sides and below silvery-white. Line of demarcation from shoulder bounded only by dull leaden line. Side of head, iris and beak silvery-white. Fins all pale. Length 308 mm.

The above example agrees largely with Le Sueur's description,\* except he says "lateral line very low, interrupted by ventral fins, and beginning to rise above the base of the anal, are then continued along the middle of the tail upon the carina." What is intended by "pectoral fins small, longer than the half of the space which separates

\* Cat. F. Brit. Mus., VIII, 1871, p. 100. Cuba.

† An. Amér. Sud, Poiss., 1855, p. 82, Pl. 42, fig. 3 (head). Rio Janeiro.

‡ Journ. Acad. Nat. Sci. Phila., II, pt. 1, 1821, p. 125, Pl. 10, fig. 1. Island of Guadeloupe.

their base from the tail" is not clear. Now his figure varies in several respects, and the details are slightly obscure. The dorsal has 26 rays and the anal about 24 ?, the eye about  $1\frac{1}{2}$  in postocular, first dorsal ray  $1\frac{1}{2}$ , first anal ray  $1+\frac{1}{2}$ , least depth of caudal peduncle  $6\frac{1}{2}$ , ventral  $1\frac{1}{2}$ , postocular about 5 in rest of head, pectoral  $8\frac{1}{2}$  in total head length, lower caudal lobe about  $4\frac{1}{2}$ , first anal ray 5 and pectoral 7 or 8 times to ventral.

I have recently examined material sent by the United States National Museum from the Azores and Ascension Island, which I identified as *B. trachura* Valenciennes and appears in every way identical. It is also quite evident that *Belone ardeola* Valenciennes and *B. cigonella* Valenciennes are other synonyms. This species is not a *Tylosurus* as Jordan<sup>9</sup> has recently announced, but a *Belone* belonging to my subgenus *Platybelone*.

15. *Strongylura timneu* (Walbaum).

(*Belone diploania* Cope, Trans. Amer. Philos. Soc. Phila., n. s., XIV, 1871, p. 481.)

Head  $2\frac{2}{3}$ ; depth 15; D. II, 14; A. III, 15; scales 230 from shoulder to caudal base and 10 more on latter; 155 scales from occiput to dorsal origin; eye  $2\frac{2}{3}$  in postocular; interorbital  $2\frac{1}{2}$ ; first branched dorsal ray  $1\frac{1}{2}$ ; first branched anal ray 1; least depth of caudal peduncle  $4\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ ; postocular  $3\frac{1}{2}$  in rest of head; pectoral 4; lower caudal lobe about 4. Body subcylindrical, caudal peduncle slightly depressed, width behind slightly less than its depth. Head large, with long slender jaws, lower little longer. Eye large, next to upper profile. Maxillary not quite to pupil, little behind front eye edge, largely concealed. Teeth small. Jaws not completely closing basally. Interorbital depressed, broad, very slightly concave. Nasal cavity little less than pupil. No rakers. L. I. runs along lower body edge, ascends caudal peduncle at middle of side and then straight to caudal base medially. Head largely scaly, over sides at least, also including preorbital, side of mandible and maxillary. Dorsal origin well behind anal origin or slightly nearer caudal base than ventral origin, front lobe well elevated. Anal like dorsal, little larger. Caudal emarginate behind, lower lobe little longer. Pectoral pointed,  $2\frac{1}{2}$  to ventral, latter inserted slightly nearer caudal base than hind eye edge, about  $\frac{1}{2}$  to anal. Color in alcohol faded pale brown on back, sides and lower surface silvery-white. Line of demarcation along back distinct, leaden, and below closely parallel,

<sup>9</sup> Proc. U. S. Nat. Mus., 55, 1919, p. 398.

narrow, pale yellowish line. Side of head and iris silvery-white. Slight dusky tint on opercle behind and above. Vertical fins and pectoral grayish, ventral paler. Length 305 mm. No. 7,572, A. N. S. P., type of *B. diplotaenia* Cope.

Identical with *S. timucu* (Walbaum), differing apparently in the lateral bluish stripe edged with black and then yellowish all along below. Cope says of *B. diplotaenia* eye 2.5 in postorbital, eye equals interorbital and pectoral equals postorbital, though I find the pectoral about half an eye-diameter longer than postocular.

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| 16. <i>Hyporhamphus unifasciatus</i> (Ranzani).  | 34. <i>M. venenosa apua</i> (Bloch).                           |
| 17. <i>Pareuzacetus mesogaster</i> (Bloch).  | 35. <i>Hypoplectrus unicolor crocotus</i> (Cope).              |
| 18. <i>Cypselurus heterurus</i> (Rafinesque).  | ( <i>Plectropoma crocota</i> Cope, l. c., p. 467, fig. 3.)     |
| *19. <i>Aulostomus maculatus</i> Valenciennes.   | 36. <i>Rypticus coriaceus</i> (Cope).                          |
| 20. <i>Atherina laticeps</i> Poey.   | ( <i>Eleutheractis coriaceus</i> Cope, l. c., p. 467, fig. 3.) |
| 21. <i>Sphyræna barracuda</i> (Walbaum).   | †37. <i>Lutjanus synagris</i> (Linné).                         |
| †22. <i>Hippocampus punctulatus</i> Guichenot.   | 38. <i>Ocyurus chrysurus</i> (Bloch).                          |
| 23. <i>Myripristis jacobus</i> Cuvier.   | 39. <i>Rhomboplites aurorubens</i> (Cuvier).                   |
| 24. <i>Holocentrus ascensionis</i> (Osbeck).   | 40. <i>Hæmulon melanurum</i> (Linné).                          |
| 25. <i>Scomberomorus cavalla</i> (Cuvier).   | 41. <i>Bathystoma aurolineatum</i> (Cuvier).                   |
| 26. <i>Trichiurus lepturus</i> Linné.  | 42. <i>Genyatremus luteus</i> (Bloch).                         |
| †27. <i>Blepharis crinitus</i> (Mitchill).   | *43. <i>Eucinostomus pseudogula</i> Poey.                      |
| 28. <i>Vomer spirii</i> (Swanison).  | 44. <i>E. gula</i> (Quoy and Gaimard).                         |
| 29. <i>Trachinotus glaucus</i> (Bloch).  | 45. <i>Upeneus martinicus</i> Cuvier.                          |
| 30. <i>Pempheris mulleri</i> Poey.   | 46. <i>Bairdiella ronchus</i> (Cuvier).                        |
| 31. <i>Epinephelus maculosus</i> (Valenciennes).   |  |
| 32. <i>Alphestes chloropterus</i> (Cuvier).  |  |
| 33. <i>Mycteroperca acutirostris</i> (Valenciennes).   |  |
| ( <i>Epinephelus chalinus</i> Cope, Trans. Amer. Philos. Soc. Phila. n. s. XIV, 1871, p. 465.) |  |
47. *Umbrina coroides* Cuvier.

Head  $3\frac{1}{2}$  to  $3\frac{3}{4}$ ; depth 3 to  $3\frac{1}{2}$ ; D. X, I, 26 to X, I, 28; A. II, 6; scales 49 in l. l. to caudal base; snout  $3\frac{1}{2}$  in head; eye  $4\frac{1}{4}$  to  $4\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$  to  $2\frac{3}{4}$ ; interorbital  $3\frac{1}{2}$  to  $3\frac{3}{4}$ . Body well compressed, deep, back elevated. Caudal peduncle compressed. Head moderate, compressed. Snout convex, about broad as long. Eye elevated, hind edge midway in head length. Mouth small, inferior, lower jaw included. Maxillary about to front pupil edge. Teeth fine, in bands in jaws. Nostrils together, close before eye. Interorbital convex. Hind preopercle edge finely serrate, and serræ become little enlarged toward angle. Broad preorbital equals eye. Rakers 5 or 6+8 or 9 rudimentary points, fourth or less than filaments, and latter  $1\frac{3}{4}$  in eye. L. l. arched nearly concurrent with dorsal profile. Second dorsal spine longest, fin inserted slightly behind

pectoral origin, and depressed tip not quite to soft dorsal origin, which midway between front or hind nostril and caudal base. Soft dorsal nearly uniformly low. Anal inserted about midway between ventral origin and caudal base, second spine enlarged,  $2\frac{2}{3}$  to  $2\frac{3}{4}$  in head. Pectoral and ventral about equal,  $1\frac{1}{2}$  to  $1\frac{3}{4}$  in head. In alcohol faded largely uniform brownish, centers of scale rows slightly darker. Lower surface with traces of silvery. Spinous dorsal and caudal tinged dusky. Length of larger 203 mm. (caudal end damaged).

Cope originally separated these two examples as varieties of *U. broussoneti* Cuvier, the smaller and longer example without brown vertical bars and the larger deep one with nine vertical bars.

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| 48. <i>Eques lanceolatus</i> (Linné).                       | 53. <i>Halichares cyanocephalus</i> (Bloch).                          |
| 49. <i>Polydactylus plumieri</i> Lacepede.                  | 54. <i>H. bivittatus</i> (Bloch).                                     |
| †50. <i>Pomacentrus leucostictus</i> (Müller and Troschel). | 55. <i>Cryptotomus roseus</i> Cope.                                   |
| 51. <i>Abudefduf marginatus</i> (Bloch).                    | (Trans. Amer. Philos. Soc. Phila., n. s., XIV, 1871, p. 462, fig. 1.) |
| †52. <i>Microspathodon chrysurus</i> (Cuvier).              |   |

56. *Sparisoma hoplomystax* (Cope).

(*Scarus hoplomystax* Cope, l. c.)

Head 3; depth  $2\frac{2}{3}$ ; D. IX, 10; A. II, 9; scales 23 in l. l. to caudal base and 2 more on latter; 2 scales above l. l. to spinous dorsal origin and 6 below to anal origin; 4 predorsal scales; snout  $2\frac{2}{3}$  in head; eye  $4\frac{1}{2}$ ; mouth  $4\frac{1}{2}$ ; interorbital  $4\frac{1}{2}$ . Body well compressed, ovoid, deepest about middle of pectoral. Caudal peduncle compressed, least depth  $2\frac{1}{2}$  in head. Head compressed, upper profile little more inclined. Snout about long as wide, muzzle compressed. Eye elevated, hind edge about midway in head length. Pupil ellipsoid. Mouth gape slightly inclined forward, about  $\frac{2}{3}$  to eye or not quite to front nostril. Three canines on outer face of upper jaw, all flaring out, front pair close together and directed forward. Ten oblique rows of teeth along each side of lower jaw. Front nostril about half an eye-diameter before eye, with fleshy filament about  $\frac{1}{4}$  same. Interorbital slightly depressed concavely in front, slightly convex behind. Rakers 4+12 flexible points,  $\frac{1}{2}$  of filaments and latter about  $4\frac{1}{2}$  in head. Tubes in l. l. arborescent. Row of 5 large scales on cheek. Dorsal spines quite pungent, mostly uniform, second  $3\frac{1}{2}$  in head, fin edge entire. Soft dorsal similar, inserted about midway between upper end of gill-opening and caudal base. Anal opposite and like soft dorsal. Caudal convex behind. Pectoral  $1\frac{1}{2}$  in head, about  $\frac{2}{3}$  to anal. Ventral inserted slightly behind pectoral base, fin  $\frac{2}{3}$  to anal. Color in alcohol above largely dull brown-

ish, line of demarcation from level with eye to caudal base medially distinct, with paler brownish color below. Body everywhere with obscure paler or whitish dots or specks, and many obscure darker reticulations above and on side of head. Snout, cheek and head above with many brownish dots. An obscure pale streak from rictus across chin. Pectoral axil and suprascapula with dusky-brown tinge. Pectoral base with row of fine whitish dots. Vertical fins pale brownish, specked or dotted with darker and whitish. Pectoral and ventral pale, latter whitish terminally. Length 139 mm. Type (cotype) of *S. hoplomystax* Cope, No. 9,305, A. N. S. P.

Also Nos. 9,306 and 9,307, and 9,283 to 9,285, cotypes, A. N. S. P. These show: Head  $2\frac{2}{3}$  to 3; depth  $2\frac{2}{3}$  to  $2\frac{3}{4}$ ; D. IX, 10; A. II, 9; scales 23 in l. l. to caudal base and 2 more on latter; snout  $2\frac{2}{3}$  to  $2\frac{3}{4}$  in head; eye 4 to  $4\frac{1}{2}$ ; mouth  $4\frac{1}{2}$  to  $5\frac{1}{2}$ ; interorbital  $4\frac{1}{4}$  to  $5\frac{1}{8}$ ; length 112 to 123 mm.

57. *Sparisoma aurofrenatum* (Valenciennes).

60. *S. flavescens* (Schneider).

Recorded by Cope as *Scarus radians*.

58. *S. abildgaardi* (Bloch).

\*59. *S. distinctum* (Poey).

61. *Callyodon punctulatus* (Valenciennes).

One example, listed by Cope as *Scarus psittacus* and wrongly included as a synonym of *Scarus taeniopterus* Desmarest by Jordan,<sup>10</sup> who thinks *Scarus diadema* Valenciennes a synonym of the present species. While doubtless his material agrees with the account by Valenciennes,<sup>11</sup> *C. punctulatus* is distinguished from *C. diadema* by having its anal fin medianly throughout speckled with dusky. *C. diadema* agrees, however, in the presence of the yellow transverse line connecting the eyes across the interorbital. In *C. taeniopterus* this is not present, though there is a rather broad yellowish band forward from front edge of eye towards end of snout, there meeting its fellow.

62. *C. diadema* Valenciennes.

63. *C. taeniopterus* (Desmarest).

\*64. *C. croicensis* (Bloch).

Five small examples appear to belong here as they have 2 rows of cheek scales, a rounded caudal and without hind canines above. Although in bad preservation traces of the 2 dark longitudinal bands may be made out. Largest 64 mm.

<sup>10</sup> Rep. U. S. F. Com., XV, 1887 (1891), p. 683.

<sup>11</sup> Hist. Nat. Poiss., XIV, 1839, p. 146.

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| 65. <i>Pseudoscarus guacamaia</i> (Cuvier). | 69. <i>Pomacanthus paru</i> (Bloch).       |
| 66. <i>Chaetodon sedentarius</i> Poey.      | 70. <i>Holacanthus tricolor</i> (Bloch).   |
| *67. <i>C. striatus</i> Linné.              | 71. <i>Angelichthys ciliaris</i> (Linné).  |
| †68. <i>C. capistratus</i> Linné.           | *72. <i>Hepatus caeruleus</i> (Schneider). |

73. *Balistes forcipatus* Gmelin.

(*Balistes moribundus* Cope, Trans. Amer. Philos. Soc. Phila., n. s., XIV, 1871, p. 479.)

Head  $2\frac{2}{3}$ ; depth  $1\frac{1}{3}$ ; D. III—29; A. 26; about 42 indistinct scales in median lateral series between gill-opening and caudal base and 4 more on latter<sup>12</sup>; snout  $1\frac{2}{3}$  in head; eye  $3\frac{1}{4}$ ; interorbital  $2\frac{1}{4}$ ; fifth dorsal ray 2; fifth anal ray  $2\frac{1}{2}$ ; least depth of caudal peduncle 3; caudal  $1\frac{3}{4}$ ; pectoral  $2\frac{1}{2}$ . Body contour ellipsoid, compressed, deepest medially. Caudal peduncle and head compressed, latter with upper profile nearly straight and lower slightly convex. Muzzle well compressed, preorbital slightly concave, width about half its length. Mouth small, very slightly superior. Teeth in jaws enlarged medially, each with concave edge. Nostrils together, close before upper front eye edge. Interorbital convex. Gill-opening slightly oblique, about  $\frac{1}{4}$  of eye. Body finely spinescent, each scale with about 2 uneven rows of spinules. First dorsal spine robust, spiny in front and spines larger above, its length (broken) at least twice that of third. Soft dorsal origin midway between hind pupil edge and caudal base, front rays highest and fin rounded. Anal similar, opposite. Caudal rounded. Pectoral small. Ventral spine spinescent and flap with 10 slender, pointed spines. Color in alcohol brownish generally, sides of head and trunk with numerous pale bluish spots. Underlaid cloudings of deeper brown and 3 dark brown blotches on back below soft dorsal, larger and more indistinct one below spinous dorsal, and all reflected slightly on fins basally. Membranes of spinous dorsal dusky. Iris deep brown. Fins pale brownish, basally with several somewhat irregular rows of whitish spots. Length 56 mm. No. 781, A. N. S. P., type of *B. moribundus* Cope.

74. *B. vetula* Linné.75. *Canthidermis sobaco* Poey.

(*Balistes asperimus* Cope, Trans. Amer. Philos. Soc. Phila., n. s., XIV, 1871, p. 478.)

Head  $2\frac{2}{3}$ ; depth  $1\frac{1}{3}$ ; D. III—26; A. 24; scales about 51 in median lateral series between gill-opening and caudal base and 4 more on latter; snout  $1\frac{2}{3}$  in head; eye  $3\frac{1}{4}$ ; interorbital  $2\frac{2}{3}$ ; first dorsal spine

<sup>12</sup> Not 60 as given by Jordan and Evermann, Bull. U. S. Nat. Mus., Bull. 47, II, 1898, p. 1702.

1 $\frac{1}{2}$ ; eighth dorsal ray 1 $\frac{1}{2}$ ; fifth anal ray 1 $\frac{1}{2}$ ; least depth of caudal peduncle 2 $\frac{1}{2}$ ; free caudal rays 2; pectoral 2 $\frac{3}{4}$ . Body deep, well compressed, deepest medially. Caudal peduncle and head compressed, profiles of latter alike. Muzzle well compressed, preorbital depressed, width 1 $\frac{1}{2}$  its length. Mouth small, terminal. Teeth enlarged medianly in jaws, each with slight concave edge. Nostrils close together, close before front eye edge medially. Interorbital depressed concavely, rather blunt, occipital ridge extending up behind. Gill-opening rather slightly oblique, about  $\frac{1}{4}$  of eye. Body everywhere roughly spinescent, spinules largest on middle of side below and about ventral flap. All unpaired fin-rays with row of fine spinules laterally, rows dividing and following branches terminally. Humeral region finely spinescent. First dorsal spine inserted slightly behind eye over gill-opening. Double row of spines down front and one row down each side of first dorsal spine, second and third spines barely  $\frac{1}{2}$  of first. Soft dorsal origin about midway between hind pupil edge and caudal base, front median rays highest, fin rounded. Anal similar, opposite. Caudal small, hind edge convex. Pectoral small. Ventral spine spinescent, flap with about 7 irregular small spines not larger than adjacent ones. Color in alcohol rather warm brownish generally, scarcely paler below, and clouded pattern of broad, dark variable lines or reticulations. Dorsal and anal bases each with 3 dark brown blotches, extending as irregular lines on fins. Iris brown. Length 82 mm. Type, of *B. asperimus* Cope, No. 800, A. N. S. P.

Though Cope gives the type "locality uncertain, but probably St. Martins, W. I.," the original label says "Darien."

76. *Canthidermis sufflamen* (Mitchill).

An adult example recorded by

Cope as *Balistes sobacus*.

†77. *Xanthichthys ringens* (Linné).

78. *Cantherines pullus* (Ranzani).

79. *Monacanthus ciliatus* (Mitchill).

Listed as *M. tomentosus* by Cope.

80. *Pseudomonacanthus amphioxys* (Cope).

(*Monacanthus amphioxys* Cope, Trans. Amer. Philos. Soc. Phila., n. s., XIV, 1871, p. 477.)

Head 2 $\frac{1}{2}$ ; depth 1 $\frac{1}{2}$ ; D. II—35; A. 30; snout 1 $\frac{1}{2}$  in head; eye 3 $\frac{1}{2}$ ; interorbital 3 $\frac{1}{4}$ ; first dorsal spine 1 $\frac{1}{2}$ ; least depth of caudal peduncle 3 $\frac{1}{4}$ ; free caudal rays 2 $\frac{1}{2}$ ; pectoral about 2 $\frac{3}{4}$ . Body rather elongately ellipsoid, compressed, deepest medially. Caudal peduncle and head well compressed, latter with upper profile slightly concave, lower equally convex. Muzzle well compressed, preorbital strongly concave, width about 3 in length. Mouth small, very slightly superior. Median enlarged lower teeth larger than upper, all with well-notched



edges. Nostrils together, close before front eye edge. Interorbital convex. Gill-opening little inclined, below hind part of eye and equals eye. Body minutely spinescent, slightly rough to touch. First dorsal spine inserted over middle of eye, with row of antrorse serræ along each front edge and another on each hind edge, all becoming smaller towards spine base. Second dorsal spine barely  $\frac{1}{4}$  of first. Soft dorsal inserted about midway between front eye edge and caudal base, front median rays longest, apparently (damaged) not over half of first dorsal spine. Anal largely opposite, its origin slightly behind dorsal origin. Caudal slightly convex behind. Pectoral small. Ventral spine rigid, with pair of spines in front, another pair behind and several each side. Color in alcohol pale uniform brownish generally, with brassy reflections below. Iris whitish. Length 61 mm. Cotype (type) of *M. amphioxys* Cope, No. 777, A. N. S. P.

No. 778, same data, cotype in poor condition, about same size. Also No. 779, cotype, same size. It has: Head  $2\frac{3}{8}$ ; depth  $1\frac{1}{8}$ ; D. II—35; A. 32; snout  $1\frac{1}{4}$  in head; eye  $3\frac{1}{4}$ ; interorbital  $3\frac{1}{4}$ ; first dorsal spine  $1\frac{1}{8}$ .

†81. *Alutera scripta* (Osbeck).

82. *Lactophrys triqueter* (Linné).

†83. *L. bicaudalis* (Linné).

†84. *L. trigonus* (Linné).

85. *L. tricornis* (Linné).

86. *Spheroides spengleri* (Bloch).

\*87. *S. marmoratus* (Ranzani).

Recorded as *Tetrodon reticularis* by Cope. On comparison with an example from Pine Island, Florida, which I recorded as the preceding species,<sup>13</sup> I find such to be wrong and that it agrees with Cope's St. Martin's example.

\*88. *S. testudineus* (Linné).

89. *Canthigaster rostratus* (Bloch).

90. *Chilomycterus atinga* (Linné).

91. *Eleotris perniger* (Cope).

(*Culius perniger* Cope, Trans. Amer. Philos. Soc. Phila., n. s., XIV, 1871, p. 473.)

Head  $3\frac{1}{2}$ ; depth 4; D. VI—I, 8, 1; A. I, 8, 1; scales 66 from head to caudal base and 4 more on latter; 22 scales transversely between soft dorsal and anal origins; 58 predorsal scales; head width  $1\frac{1}{2}$  its length; mandible  $2\frac{1}{2}$ ; third dorsal spine  $2\frac{1}{2}$ ; seventh dorsal ray  $1\frac{1}{2}$ ; seventh anal ray  $1\frac{1}{2}$ ; least depth of caudal peduncle  $2\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ ; ventral  $1\frac{1}{2}$ ; snout  $4\frac{1}{4}$  in head from upper jaw tip; eye  $6\frac{1}{2}$ ; maxillary  $2\frac{1}{2}$ ; interorbital  $3\frac{1}{2}$ . Body compressed, deepest at soft dorsal origin. Caudal peduncle well compressed, least depth  $1\frac{1}{2}$  its length. Head

<sup>13</sup> Proc. Acad. Nat. Sci. Phila., 1915, p. 251.

about deep as wide, upper profile deeply concave over eyes. Snout broad, convex, length  $\frac{3}{4}$  its width. Eye small, ellipsoid, high, hind edge at first  $\frac{1}{4}$  in head. Teeth fine, in bands in jaws, inner row in each enlarged little. Maxillary reaches eye. Lower jaw well protruded. Nostril small, inconspicuous, near snout edge. Interorbital broadly convex, elevated behind. Preopercle with strong spine down and forward. Gill-opening forward last  $\frac{1}{4}$  in head. Rakers 2+6 low knobs, and filaments about equal eye. Scales largely uniform, except along body edges where small and crowded. Also small on caudal base, predorsal, top of head and breast. Snout, preorbital and jaws naked, head otherwise scaly. About 15 rows of cheek scales. Dorsal spines fine, slender, fin inserted much nearer hind opercle edge than soft dorsal origin. Latter little nearer hind opercle edge than caudal base, rays elevated gradually to last, which longest. Anal similar, only its insertion little back. Pectoral long, pointed, reaches vent. Ventral pointed,  $\frac{1}{4}$  to vent. Ventral papilla long as eye. Color in alcohol largely dark brown, mottled obscurely and finely with darker. Dark brown streak from behind eye to upper opercle edge, another from lower eye edge to median preopercle edge. All fins except first dorsal finely barred with narrow dark brown wavy lines. First dorsal pale, with about 5 dark lines apparently, though very faint. Iris slaty. Length 128 mm. (caudal end damaged). Type of *C. perniger* Cope, No. 10,575, A. N. S. P.

Cope says "first dorsal with white extremity and two longitudinal black bars, one along the base," though more appear present.

92. *Mapo soporator* (Valenciennes).

\*93. *Gobiesox cephalus* Lacépède.

94. *G. cerasinus* Cope.

(Trans. Amer. Philos. Soc. Phila., n. s., XIV, 1871, p. 473.)

Head  $2\frac{2}{3}$ ; depth  $5\frac{1}{3}$ ; D. 7; A. 6; head width about  $1\frac{1}{2}$  its length; head depth at occiput about  $2\frac{1}{4}$ ; snout  $3\frac{2}{3}$ ; eye  $4\frac{2}{3}$ ; mouth width about  $2\frac{1}{4}$ ; interorbital 5; third dorsal ray  $2\frac{1}{2}$ ; third anal ray  $3\frac{1}{2}$ ; least depth of caudal peduncle  $5\frac{1}{2}$ ; caudal 2; pectoral  $2\frac{2}{3}$ . Body strongly depressed, depth about uniform. Caudal peduncle compressed, about long as deep. Head greatly depressed, convex above, flattened below. Snout depressed, broad, length  $\frac{3}{4}$  its width. Eye slightly advanced from head center, directed above and forward. Mouth broad, lower jaw much shorter. Lips thick, fleshy. Upper teeth in 4 rows in front, outer row largest, compressed and ends slightly convex. Nostrils superior on side of snout, alike, close before eye. Interorbital level. Gill-opening forward about to hind eye edge.

Rakers 6 low rudimentary knobs. Skin everywhere smooth. Lower edge of head, front disk edge (lower pectoral rays) and inner ventral faces papillose. Dorsal inserted about last third between hind eye edge and caudal base, fin  $1\frac{3}{4}$  to caudal base. Anal like dorsal, only slightly backward. Caudal truncate. Pectoral broad, not quite far back as ventral. Ventral disk rounded, about  $1\frac{1}{2}$  in head. Color in alcohol pale uniform brownish. Length 72 mm. Type, No. 10,363, A. N. S. P.

Cope gives the eye as  $3\frac{1}{2}$  in the head, and says it equals the frontal width, which agrees if the bony interorbital is intended.

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| 95. <i>Malacotenus biguttatus</i> (Cope).             | †98. <i>Histrio histrio</i> (Linné).                  |
| 96. <i>Labrisomus nuchipinnis</i> (Quoy and Gaimard). | 99. <i>Antennarius multiocellatus</i> (Valenciennes). |
| 97. <i>Platophrys lunulatus</i> (Linné).              | 100. <i>Oncocephalus vespertilio</i> (Linné).         |

#### ST. CROIX ISLAND.

Of Cope's material, reported in his memoir previously noticed, two collections were studied. The first consisted of dried skins, made by Dr. R. E. Griffiths, and the alcoholic preparations were largely from Captain Thomas Davidson, U. S. N.

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| †1. <i>Harengula pensacolæ</i> Goode.  | †25. <i>Priacanthus arenatus</i> Cuvier.                   |
| 2. <i>Synodus intermedius</i> (Agassiz).   | †26. <i>Luljanus griseus</i> (Linné).                      |
| 3. <i>Chilorhinus suensonii</i> (Lütken).  | †27. <i>L. vivanus</i> (Cuvier).                           |
| 4. <i>Hemiramphus brasiliensis</i> (Linné).  | †28. <i>Ocyurus chrysurus</i> (Bloch).                     |
| 5. <i>Aulostomus maculatus</i> Valenciennes.   | †29. <i>Apsilus dentatus</i> Guichenot.                    |
| 6. <i>Hippocampus punctulatus</i> Guichenot.   | †30. <i>Hæmulon melanurum</i> (Linné).                     |
| 7. <i>Mugil curema</i> Valenciennes.   | †31. <i>H. scuirus</i> (Shaw).                             |
| Recorded as <i>M. brasiliensis</i> by Cope.  | †32. <i>H. plumieri</i> (Lacépède).                        |
| 8. <i>Myripristis jacobus</i> Cuvier.  | 33. <i>H. flavolineatus</i> (Desmarest).                   |
| ( <i>Rhinoberyz chryseus</i> Cope, Trans. Amer. Philos. Soc. Phila. n. s., XIV, 1871, p. 464, fig. 2.) | †34. <i>Bathystoma striatum</i> (Linné).                   |
| 9. <i>Holocentrus ascensionis</i> (Osbeck).  | 35. <i>Anisotremus virginicus</i> (Linné).                 |
| 10. <i>Selar crumenophthalmus</i> (Bloch).   | †36. <i>Calamus calamus</i> (Cuvier).                      |
| 11. <i>Caranx ruber</i> (Bloch).   | 37. <i>Eucinostomus gula</i> (Quoy and Gaimard).           |
| 12. <i>C. hippos</i> (Linné).  | †38. <i>Upeneus maculatus</i> (Bloch).                     |
| 13. <i>Vomer spixii</i> (Swanison).  | 39. <i>Eques acuminatus</i> (Schneider).                   |
| 14. <i>Trachinotus glaucus</i> (Bloch).  | 40. <i>E. punctatus</i> (Linné).                           |
| 15. <i>T. falcatus</i> (Linné).  | 41. <i>E. lanceolatus</i> (Linné).                         |
| 16. <i>Petromelopon cruentatus</i> (Lacépède).   | 42. <i>Pomacentrus leucostictus</i> (Müller and Troschel). |
| 17. <i>Cephalopholis fulvus</i> (Linné).   | 43. <i>Abudefduf marginatus</i> (Bloch).                   |
| 18. <i>Epinephelus striatus</i> (Bloch).   | 44. <i>Microspathodon chrysurus</i> (Cuvier).              |
| 19. <i>Alphestes chloropterus</i> (Cuvier).  | 45. <i>Bodianus rufus</i> (Linné).                         |
| 20. <i>Mycteroperca ruber</i> (Bloch).   | *46. <i>Decodon puellaris</i> (Poey).                      |
| 21. <i>Hypoplectrus unicolor</i> (Walbaum).  | 47. <i>Clepticus paræ</i> (Schneider).                     |
| 22. <i>H. unicolor guttavarius</i> (Poey).   | 48. <i>Halichæres radiatus</i> (Linné).                    |
| 23. <i>Paranthias furcifer</i> (Valenciennes).   | 49. <i>H. poeyi</i> (Steindachner).                        |
| 24. <i>Rypticus saponaceus</i> (Schneider).  | 50. <i>H. garnoti</i> (Valenciennes).                      |
|  | 51. <i>Chlorichthys bifasciatus</i> (Bloch).               |
|  | 52. <i>Sparisoma aurofrenatum</i> (Valenciennes).          |

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| 53. <i>S. abildgaardi</i> (Bloch).           | 66. <i>Angelichthys ciliaris</i> (Linné).   |
| 54. <i>S. flavescens</i> (Schneider).        | 67. <i>Hepatus caeruleus</i> (Schneider).   |
| Recorded as <i>Scarus chrysopterus</i>       | 68. <i>H. hepatus</i> (Linné).              |
| by Cope.                                     | 69. <i>Balistes vetula</i> Linné.           |
| 55. <i>S. rubripinne</i> (Valenciennes).     | †70. <i>Xanthichthys ringens</i> (Linné).   |
| 56. <i>Callyodon diadema</i> (Valenciennes). | †71. <i>Melichthys piceus</i> Poey.         |
| 57. <i>C. taenioplerus</i> (Desmarest).      | †72. <i>Cantherines pullus</i> (Ranzani).   |
| 58. <i>C. croicensis</i> (Bloch).            | 73. <i>Lactophrys triqueter</i> (Linné).    |
| 59. <i>C. vetula</i> (Schneider).            | 74. <i>L. tricornis</i> (Linné).            |
| 60. <i>Chelodon ocellatus</i> Bloch.         | †75. <i>Scorpaena grandicornis</i> Cuvier.  |
| *61. <i>C. sedentarius</i> Poey.             | *76. <i>Labrisomus nuchipinuis</i> (Quoy    |
| 62. <i>C. striatus</i> Linné.                | and Gaimard).                               |
| 63. <i>C. capistratus</i> Linné.             | 77. <i>Platophrys lunulatus</i> (Linné).    |
| 64. <i>Pomacanthus arcuatus</i> (Linné).     | †78. <i>Antennarius multiocellatus</i> (Va- |
| 65. <i>Holacanthus tricolor</i> (Bloch).     | lenciennes).                                |

### ST. CHRISTOPHERS, BRITISH WEST INDIES.

Cope also had a small collection from this island, sometimes called St. Kitts, obtained by Benjamin H. Lightfoot.

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| †1. <i>Gymnothorax moringua</i> (Cuvier).   | 9. <i>Ocyurus chrysurus</i> (Bloch).       |
| Recorded as <i>G. rostratus</i> by          | ( <i>O. rijgersmaei</i> Cope, Trans.       |
| Cope.                                       | Amer. Philos. Soc. Phila., n. s.,          |
| 2. <i>Ablennes hians</i> (Valenciennes).    | XIV, 1871, p. 468, fig. 4.)                |
| 3. <i>Hemiramphus brasiliensis</i> (Linné). | 10. <i>Aprion macrophthalmus</i> (Müller   |
| †4. <i>Caranx hippos</i> (Linné).           | and Troschel).                             |
| *5. <i>C. latus</i> Agassiz.                | 11. <i>Conodon nobilis</i> (Linné).        |
| 6. <i>Cephalopholis fulvus</i> (Linné).     | *12. <i>Calamus calamus</i> (Cuvier).      |
| †7. <i>Epinephelus maculosus</i> (Valen-    | 13. <i>Upeneus maculatus</i> (Bloch).      |
| ciennes).                                   | 14. <i>U. martinicus</i> Cuvier.           |
| Cope mentions it as <i>E. lunu-</i>         | 15. <i>Sparisoma chrysopterus</i> (Schn.). |
| <i>latus</i> .                              | 16. <i>Pomacanthus paru</i> (Bloch).       |
| 8. <i>Lutjanus vivanus</i> (Cuvier).        | 17. <i>Holacanthus tricolor</i> (Bloch).   |
| ( <i>Lutjanus torridus</i> Cope, l. c.,     | †18. <i>Hepatus hepatus</i> (Linné).       |
| p. 469; <i>Ocyurus torridus</i> fig. 5).    | †19. <i>Balistes vetula</i> Linné.         |

### JAMAICA.

In 1892 Prof. T. D. A. Cockerell compiled "A Provisional List of the Fishes of Jamaica,"<sup>14</sup> the first attempt to collect in orderly arrangement the species mentioned in the various scattered works. The list by Richard Hill in 1855 is allocated, but as it "is little more than a catalogue of names, many of which are but doubtfully correct," it had best be discarded. As Cockerell gives a short bibliography at the end of his paper, only subsequent papers are mentioned here. *Aulostoma maculatum* and *Rhinobatos undulatus* are recorded by Cockerell<sup>15</sup> the next year, and a little later J. E. Duerden mentions a number of food fishes<sup>16</sup> and C. H. T. Townsend has remarks on *Sicydium*.<sup>17</sup> Jordan and Rutter report the collection of fishes

<sup>14</sup> Bull. No. 1, Inst. of Jamaica (Kingston), 1892, pp. 1-16.

<sup>15</sup> Journ. Inst. Jamaica, I, No. 5, January, 1893, p. 178.

<sup>16</sup> L. c., II, April, 1895, No. 11, pp. 166-7; March, 1899, No. 6, p. 614.

made by Joseph Seed Roberts in Kingston.<sup>18</sup> Boulenger describes *Ceratobatis robertsi*,<sup>19</sup> and finally the writer has given a list of a small collection of fishes obtained at Port Antonio by Charles W. Johnson and William J. Fox.<sup>20</sup>

During the early winter of 1891 Dr. J. Percy Moore made a collection of the fishes, listed below, in Jamaica. All are now contained in the University of Pennsylvania. Most are food-fishes, or such as were abundant at the time. Locality labels, other than simply Jamaica, are Kingston, Lucea, Port Antonio, and Port Moran, indicated by the letters K., L., A. and M., respectively.

1. *Ginglymostoma cirratum* (Bonnaterre).

2. *Eulamia platyodon* Poey. "Black Shark."

Teeth narrow, entire, at least below. Pectoral width half its length, reaches opposite hind basal dorsal edge. Snout length  $\frac{3}{4}$  its width. Length 1012 mm.

3. *Scoliodon terre-novæ* (Richardson). K.

8. *Gymnothorax funebris* (Ranzani). A.

4. *Sphyrna zygaena* (Linné). L.

9. *Strongylura timucu* (Walbaum). L.

5. *Elops saurus* Linné.

10. *S. raphidoma* (Ranzani). L.

6. *Albula vulpes* (Linné). L.

7. *Synodus fætens* (Linné). K.

11. *Hemiramphus brasiliensis* (Linné).

12. *Cypselurus lutkeni* (Jordan and Evermann). L.

Head  $4\frac{1}{8}$ ; depth  $5\frac{1}{8}$ ; D. 11, 11; A. 11, 8; snout  $4\frac{1}{4}$  in head; eye  $3\frac{1}{8}$ ; maxillary 4; interorbital  $2\frac{1}{4}$ . Anal base  $1\frac{1}{4}$  in dorsal base. Uppermost pectoral ray simple, second divided, third and fourth longest. Pectoral uniform dusky-brown medially, edges pale. Ventral inserted about midway between last fourth of opercle and caudal base. In alcohol dorsal pale at present, but with traces of dusky above. Length 220 mm. (caudal lobe damaged).

13. *Syngnathus mackayi* (Swain and Meek).

Head  $6\frac{1}{4}$ ; D. 30; rings 16+32; dorsal on two body rings and 6 caudal rings. Snout about  $1\frac{1}{2}$  in head. Median snout line with slight keel above and below and smaller lateral keels. Opercle with radiating striæ, not keeled. Dorsal about high as body-ring width, base  $1\frac{1}{4}$  in head. Pectoral longer than base. Tail  $1\frac{3}{4}$  in total length. Body moderately deep. In alcohol uniform brown. Length 134 mm. Probably Jamaica ?.

14. *Hippocampus punctulatus* Guichenot.

<sup>17</sup> l. c., II, April, 1895, No. 11, pp. 175-6.

<sup>18</sup> Proc. Acad. Nat. Sci. Phila., 1897, pp. 91-134.

<sup>19</sup> Ann. Mag. Nat. Hist., (6) XX, 1897, pp. 227-8.

<sup>20</sup> Proc. Acad. Nat. Sci. Phila., 1899, pp. 118-119.

D. 17. Snout  $2\frac{1}{2}$  in head. Length 65 mm. K.

15. *Fistularia tabacaria* Linné.

Upper lateral snout edges entire. About 350 mm. to end of caudal fin. A.

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| 16. <i>Mugil curema</i> Valenciennes. L.             | 21. <i>Selar crumenophthalmus</i> (Bloch). |
| 17. <i>Sphyræna barracuda</i> (Walbaum).<br>Jamaica? | 22. <i>Caranx ruber</i> (Bloch).           |
| 18. <i>S. guachancho</i> Cuvier. L.                  | 23. <i>C. hippos</i> (Linné).              |
| 19. <i>Trichiurus lepturus</i> Linné. K.             | 24. <i>C. crysos</i> (Mitchill).           |
| 20. <i>Oligoplites saurus</i> (Schneider). L.        | 25. <i>C. latus</i> Agassiz. K. L.         |
| 27. <i>Chloroscombrus chrysurus</i> (Linné).         | 26. <i>Vomer setapinnis</i> (Mitchill). L. |

Head  $4\frac{1}{2}$ ; depth  $2\frac{2}{3}$ ; snout  $3\frac{2}{3}$  in head measured from upper jaw tip; eye 4; maxillary  $2\frac{2}{3}$ ; interorbital  $3\frac{2}{3}$ . Length 290 mm. K. It differs from the nominal *C. ectemurus* Jordan and Rutter in the snout longer than the eye. Also 2 from L.

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| 28. <i>Trachinotus glaucus</i> (Bloch). L.    | 47. <i>H. sciurus</i> (Shaw). L.                           |
| 29. <i>Astrapogon stellatus</i> (Cope).       | 48. <i>H. plumieri</i> (Lacépède). A.                      |
| 30. <i>Centropomus pedimacula</i> Poey. K.    | 49. <i>Bathystoma rimator</i> (Jordan and Swain). K.       |
| 31. <i>C. mexicanus</i> Bocourt.              | 50. <i>Brachydeuterus corvinaformis</i> (Steindachner). M. |
| 32. <i>C. parallelus</i> Poey.                | 51. <i>Eucinostomus pseudogula</i> Poey. K.                |
| 33. <i>Cephalopholis punctatus</i> (Linné).   | 52. <i>E. gula</i> (Quoy and Gaimard). K.                  |
| 34. <i>Epinephelus flavolimbatus</i> Poey.    | 53. <i>Gerres rhombeus</i> Cuvier. L. A.                   |
| 35. <i>E. striatus</i> (Bloch).               | 54. <i>G. plumieri</i> Cuvier. L. K.                       |
| 36. <i>E. maculosus</i> (Valenciennes).       | 55. <i>Micropogon furnieri</i> (Desmarest). K.             |
| 37. <i>E. morio</i> (Valenciennes). L.        | 56. <i>Umbrina coroides</i> Cuvier.                        |
| 38. <i>Rypiticus arenatus</i> Cuvier.         | 57. <i>Polydactylus virginicus</i> (Linné). M.             |
| 39. <i>Priacanthus cruentatus</i> (Lacépède). | 58. <i>Lachnolaimus maximus</i> (Walbaum). L.              |
| 40. <i>Lutjanus griseus</i> (Linné).          | 59. <i>Sparisoma rubripinne</i> Valenciennes. L.           |
| 41. <i>L. jocu</i> (Schneider). K.            |  |
| 42. <i>L. analis</i> (Cuvier). K.             |  |
| 43. <i>L. synagris</i> (Linné). L. K.         |  |
| 44. <i>Ocyurus chrysurus</i> (Bloch). K. L.   |  |
| 45. <i>Hæmulon parra</i> (Desmarest). K.      |  |
| 46. <i>H. melanurum</i> (Linné).              |  |

60. *Callyodon acutus* Poey.

Head  $2\frac{1}{2}$ ; depth 3; D. IX, 10; A. II, 9; scales 17+6 and 1 more on caudal base; 2 scales above l. l., 6 below; 8 predorsal scales; snout  $2\frac{2}{3}$  in head; eye  $5\frac{1}{2}$ ; mouth  $5\frac{1}{2}$ ; interorbital  $2\frac{1}{2}$ . Body elongate, well compressed, profiles alike. Head compressed, rather pointed. Snout about long as wide. Eye slightly advanced. Mouth half way to eye. No posterior canines. Interorbital convex. Cheek with 3 rows of scales, lowest row of 4 scales on preopercle limb. L. l. interrupted by scale behind, tubes with several slight inconspicuous bifurcations. Caudal scaly basally  $\frac{2}{3}$  its length. Dorsal spines flexible. Color in alcohol with broad sulphur-yellow shade as streak below first, then widens above pectoral and extends back to caudal peduncle. Above on head leaden band as if through eye, though little wider than pupil and bordered above with sulphur-yellow,

extending back to about opposite depressed pectoral tip. Back lilac-brown, largely pale. Belly and below very pale brown. Teeth whitish. Iris yellowish. Dorsal pale hyaline greenish, base broadly and edge narrowly yellowish-brown. Anal hyaline-greenish, with narrow basal yellowish-brown line and broad submarginal band. Pectoral and ventral pale. Caudal brownish, upper and lower edges pale. Length 180 mm. L.

61. *C. caeruleus* (Bloch).

62. *C. emblematicus* (Jordan and Rutter).

Head 3; depth 3; D. IX, 10; A. III, 9; scales 17+5 and 2 more on caudal base; 2 scales above l. 1., 6 below; snout  $2\frac{2}{3}$  in head; eye 5; mouth  $4\frac{2}{3}$ ; interorbital  $3\frac{1}{4}$ . Body well compressed, profiles alike, evenly ellipsoid. Head compressed. Snout long as wide. Eye slightly advanced. No posterior canines. Interorbital convex. Cheek with 3 rows of scales, lowest row on preopercle limb of 4. Scales on caudal base over  $\frac{2}{3}$  of fin. Dorsal spines rather pungent, with flexible ends. Color in alcohol pale buff-brown generally. Broad lengthwise deep brown band from above eye to last dorsal ray bases, another from snout tip through eye to upper caudal lobe medially. Fainter third parallel band begins in cheek below pre-orbital, extends to pectoral base and then to lower caudal lobe medially, where ending in slight spots. Rows of scales below pectorals each with median white line, which extends from gill-opening till opposite vent, and rows number three. Fins all pale brownish, edges of dorsal and caudal, also caudal base, same. Length 150 mm. L.

*Callyodon margarita* Fowler,<sup>21</sup> from Panama, is undoubtedly a synonym, the four upper posterior canines simply a variation. Jordan and Evermann do not indicate the lower dark band along the lower side of the head or distinct at caudal base, and there is no indication of white abdominal lines, nor are they mentioned by Jordan and Rutter.

63. *Chatodon striatus* Linné. L.

66. *Angelichthys ciliaris* (Linné).

64. *C. capistratus* Linné. L.

67. *Hepatus caeruleus* (Schneider). A.

65. *Pomacanthus arcuatus* (Linné). L.

68. *Melichthys piceus* Poey.

D. III—34; A. 32; scales 55 from gill-opening to caudal base; snout  $1\frac{1}{4}$  in head; eye  $4\frac{1}{2}$  in snout; interorbital  $1\frac{1}{2}$ ; first dorsal spine  $1\frac{1}{2}$ ; pectoral  $1\frac{1}{2}$ . Caudal truncate, ends pointed. Color in alcohol

<sup>21</sup> Proc. Acad. Nat. Sci. Phila., 1917, p. 133, fig. 2. Colon.

black, with narrow white line along dorsal and anal bases. Caudal entirely black. Length 295 mm. L.

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|---|---|
| 69. <i>Monacanthus hispidus</i> (Linné). K.   | 78. <i>Dactylopterus volitans</i> (Linné). K. |
| 70. <i>Alutera punctata</i> Agassiz. K.       | 79. <i>Philypnus dormitor</i> (Lacépède). L.  |
| 71. <i>Lactophrys triqueter</i> (Linné).      |   |
| 72. <i>L. tricornis</i> (Linné). K. A. L.     | 80. <i>Mapo soporator</i> (Valenciennes). L.  |
| 73. <i>L. bicaudalis</i> (Linné). L.          |   |
| 74. <i>Spheroides testudineus</i> (Linné). K. | 81. <i>Ctenogobius lyricus</i> (Girard). L.   |
| 75. <i>Chilomycterus atinga</i> (Linné). L.   | 82. <i>Gobionellus oceanicus</i> (Pallas). L. |
|   | 83. <i>Leptecheneis naucratis</i> (Linné). K. |
| 76. <i>Scorpena plumieri</i> Bloch. L.        | 84. <i>Malacanthus plumieri</i> (Bloch).      |
| 77. <i>Prionotus rubio</i> Jordan. K.         |   |

85. *Gobiesox cerasinus* Cope.

D. 6. A. 7. Upper teeth irregularly in several series, and lower teeth entire incisors. Head broad as long. Color in alcohol pale brownish, apparently reddish when fresh.

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| 86. <i>Malacotenus gillii</i> (Steindachner). | 88. <i>Achirus lineatus</i> (Linné). L.         |
| 87. <i>Citharichthys spilopterus</i> Günther. | 89. <i>Oncocephalus vespertilio</i> (Linné). L. |

#### HAYTI.

While at Port-au-Prince in December, 1917, Mr. P. C. Houseman secured a few fishes which he presented to the Academy. They are listed below. The few papers relative to the fish-fauna of Hayti-Santo Domingo, are chiefly Hilgendorf's account<sup>22</sup> and the notes on the Eckman collection by Lönnberg.<sup>23</sup> Various scattered records and descriptions are found in the principal works of Cuvier, Valenciennes, Dumeril, Gunther and Vaillant and Bocourt. Evermann and Clark<sup>24</sup> described several new forms more recently and the viviparous cyprinodonts are included in Regan's paper,<sup>25</sup> while *Rivulus heyei* is described by Nichols.<sup>26</sup> Finally, the writer<sup>27</sup> reported the Gabb collection from Santo Domingo, received at the Academy in 1871, 1872 and 1874.

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|-------------------------------------|---------------------------------------|
| 1. <i>Atherina laticeps</i> Cuvier. | 3. <i>Abudefduf mauritii</i> (Bloch). |
| 2. <i>Gerres rhombeus</i> Cuvier.   |                                       |

#### BAHAMAS.

Cope gives the first faunal list in his "Ichthyology of the Lesser Antilles," already referred to. This was based on the collection made by Dr. H. C. Wood at Nassau, and received at the Academy

<sup>22</sup> Sitz. Ges. Naturf. Freunde Berlin, 1889, pp. 51-55.

<sup>23</sup> Oefvers. Svensk. Vet. Akad. Förh., LII, 1895, pp. 657-663.

<sup>24</sup> Proc. U. S. Nat. Mus., XXX, 1906, pp. 851-855, figs. 1-3.

<sup>25</sup> Proc. Z. S. London, 1913, pp. 977-1018, Pls. 99-101.

<sup>26</sup> Bull. Amer. Mus. N. Hist. N. Y., XXXIII, 1914, pp. 143-144.

<sup>27</sup> Copeia, No. 24, November 19, 1915, p. 50.



in 1861. Such material as is still extant and which I examined is indicated by the prefixed asterisk. Several subsequent papers by Jordan and Bollman,<sup>28</sup> Garman<sup>29</sup> and B. A. Bean<sup>30</sup> are important contributions. In November and December of 1890 Dr. J. Percy Moore visited New Providence Island at Port Nassau, Grand Inagua, Fortune Island, Eleuthera, and Grand Cayman, localities indicated respectively by P., G., F., E. and C. This material, with a few fishes obtained at Port Nassau by the late Prof. C. S. Dolley, is in the University of Pennsylvania.<sup>41</sup>

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|---|---|
| *1. <i>Harengula pensacolæ</i> Goode. E.  | 20. <i>Diplectrum formosum</i> (Linné). E.                  |
| *2. <i>H. macrophthalmus</i> (Ranzani).   | 21. <i>Rypticus saponaceus</i> (Schneider).                 |
| 3. <i>Conger conger</i> (Linné). C.   | G.  |
| *4. <i>Gymnothorax moringua</i> (Cuvier).   | 22. <i>Lutjanus griseus</i> (Linné). G., P.                 |
| 5. <i>Ezocetus volitans</i> Linné. North  | 23. <i>L. apodus</i> (Walbaum). F.                          |
| of Bahama Bank.   | *24. <i>L. analis</i> (Cuvier). F.                          |
| *6. <i>Hippocampus punctulatus</i> Guichenot.   | *25. <i>L. brachypterus</i> Cope.                           |
| One from Mrs. G. A. Hubbell.  | ( <i>Lutjanus brachypterus</i> Cope,                        |
| *7. <i>Holocentrus ascensionis</i> (Osbeck).  | l. c., p. 470.)   |
| F.  | *26. <i>Ocyurus chrysurus</i> (Bloch). P.                   |
| *8. <i>H. siccifer</i> Cope.  | *27. <i>Hæmulon album</i> Cuvier. G., P.                    |
| ( <i>Holocentrum sicciferum</i> Cope,   | *28. <i>H. melanurum</i> (Linné). P.                        |
| Trans. Amer. Philos. Soc. Phila.  | 29. <i>H. sciurus</i> (Shaw).                               |
| XIV, 1871, p. 465.)   | *30. <i>H. plumieri</i> (Lacépède). P., G.                  |
| *9. <i>Selar crumenophthalmus</i> (Bloch).  | *31. <i>H. flavolineatum</i> (Desmarest). F.                |
| *10. <i>Caranx ruber</i> (Bloch).   | *32. <i>Anisotremus virginicus</i> (Linné).                 |
| *11. <i>Trachinotus glaucus</i> (Bloch).  | 33. <i>Calamus calamus</i> (Valenciennes).                  |
| *12. <i>Astrapogon stellatus</i> (Cope).  | F., P.  |
| ( <i>Apogonichthys stellatus</i> Cope,  | *34. <i>C. bajonado</i> (Schneider). P.                     |
| l. c., p. 400.)   | 35. <i>C. proridens</i> Jordan and Gilbert.                 |
| *13. <i>Petromelapon cruentatus coronatus</i> .   | E.  |
| *14. <i>Cephalopholis fulvus</i> (Linné). G.,   | *36. <i>Eucinostomus pseudogula</i> Poey.                   |
| P., E., F.  | *37. <i>E. gula</i> Quoy and Gaimard.                       |
| *15. <i>C. fulvus ouatalibi</i> (Valenciennes).   | *38. <i>Upeneus martinicus</i> Cuvier. G.                   |
| 16. <i>Epinephelus niveatus</i> (Valenciennes). P.  | 39. <i>U. maculatus</i> (Bloch). P.                         |
| *17. <i>E. striatus</i> (Bloch).  | 40. <i>Micropogon furnieri</i> (Desmarest).                 |
| Several examples in the University collection, one from Nutria and one from Prof. Dolley. | F.  |
| *18. <i>E. maculosus</i> (Valenciennes).  | *41. <i>Pomacentrus leucostictus</i> (Müller and Troschel). |
| 19. <i>E. ascensionis</i> (Osbeck). Conez   | *42. <i>Abudefduf marginatus</i> (Bloch).                   |
| (Dolley).   | *43. <i>Lachnolaimus maximus</i> (Walbaum).                 |
|   | *44. <i>Bodianus rufus</i> (Linné).                         |
|   | 45. <i>Halichares bivittatus</i> (Bloch). F.                |
|   | *46. <i>Chlorichthys bifasciatus</i> (Bloch).               |

47. *Sparisoma niphobles* Jordan and Bollman.

Upper canine each side. Caudal truncate when expanded, slightly emarginate when closed. No scarlet stripe below eye to mouth

<sup>28</sup> Proc. U. S. Nat. Mus., 1889, pp. 549-553.

<sup>29</sup> Bull. Lab. Univ. Iowa, IV, 1896, pp. 76-93, 4 Pls.

<sup>30</sup> The Bahama Islands (Baltimore), 1905, pp. 293-325. Pl.

<sup>41</sup> I also found *Ezocetus volitans* Linné, *Atherina laticeps* Poey and *Mugil curema* Valenciennes, in the University collection labeled Crooked Island, French West Indies.

angle. Pectoral  $4\frac{1}{2}$  in total length. Pectoral base dusky, axillary spot obsolete. Opercular edge brownish, not dusky. Chin and head below pale uniform brownish. Length 190 mm. G.

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| 48. <i>S. aurofrenatum</i> (Valenciennes). G.   | *62. <i>Spheroides spengleri</i> (Bloch).  |
| 49. <i>S. abildgaardi</i> (Bloch). P.           | *63. <i>Chilomycterus atinga</i> (Linné).  |
| 50. <i>S. rubripinne</i> (Valenciennes). G.     | *64. <i>Dactylopterus volitans</i> (Linné).  |
| 51. <i>Callyodon tanipterus</i> (Desmarest). G. | *65. <i>Mapo soporator</i> (Valenciennes).   |
| *52. <i>Chaetodon ocellatus</i> Bloch.          | *66. <i>Leptecheneis naucrates</i> (Linné).  |
| 53. <i>C. capistratus</i> Linné. G.             | 67. <i>Malacanthus plumieri</i> (Bloch).<br>P., C.   |
| *54. <i>Pomacanthus arcuatus</i> (Linné).       | 68. <i>Carapus affinis</i> (Günther).<br>Two from the Bahamas, in 1877<br>(Dolley).  |
| *55. <i>Angelichthys ciliaris</i> (Linné). G.   | *69. <i>Malacotenus biguttatus</i> (Cope).<br>( <i>Labrisomus biguttatus</i> Cope,<br>Trans. Amer. Philos. Soc. Phila.<br>n. s., XIV, 1871, p. 473.) |
| *56. <i>Hepatus caeruleus</i> (Schneider).      | 70. <i>Platyphrys lunatus</i> (Linné).   |
| *57. <i>H. hepatus</i> (Linné).                 |  |
| 58. <i>H. bahianus</i> (Castelnau). P.          |  |
| *59. <i>Alutera schoepffii</i> (Walbaum).       |  |
| 60. <i>Lactophrys triquetus</i> (Linné). G.     |  |
| *61. <i>L. tricornis</i> (Linné). G.            |  |

#### FLORIDA.

During March and April, 1918, a small collection of rather large commercial fishes was sent to the Academy for determination in fresh state. As several were desiderata they were placed in the museum. In the summer of 1916 a number of live fishes as sent to the Philadelphia Aquarium from Key West, and afterward several were received at the Academy. The latter are indicated below by the prefixed asterisk. On March 10, 1917, Mr. Morgan Hebard collected a few fishes at Biscayne Bay and Soldier Key. During May of 1919 Mr. Hebard made another collection, at Useppa Island in Charlotte Harbor. All his material has kindly been presented to the Academy, and I am further indebted to him for the field-notes, common names, etc., included below. Localities given below refer to his material exclusively.

##### 1. *Jenkinsia stollifera* (Jordan and Gilbert).

Color in life translucent. Found in large schools in deep water. Useppa Island.

##### 2. *Harengula pensacola* Goode and Bean. "Hard-scaled Sardine."

With the next in large schools in deep water. Both shy and taken in cast-nets. Useppa Island.

##### 3. *Opisthonema oglinum* (Le Sueur). "Soft-scaled Sardine."

##### 4. *Fundulus grandis* Baird and Girard. "Chub."

Largest female 145 mm. and male 103 mm. When fresh male with hind caudal edge rather broadly gray-white, though pale bluish in the live fish while in the water. Anal and dorsal basally, and

caudal, with fine white dots. Upper dorsal edge, most of anal, and all of ventral and pectoral rich orange. In life each scale on sides with the pale or median areas of the preserved fish brilliant metallic greenish-blue.

These fish live in polluted shallow water, not roving about, and where the bottom is a dark ooze. The larger females were found in the deeper shoals in schools, usually about sandy bottoms. They were active, constantly moving about. In life much paler. Useppa Island.

5. *Cyprinodon mydrus* Goode and Bean.

Lives on sandy bottoms in shoals. Though shy during the day they were easily captured at night with a light. Like the "sand perch" the dark vertical bands are conspicuous features at night as viewed from above with the aid of an artificial light. The bands disappear, however, as soon as the fish are lifted from the water. In life the spots on the head and trunk are very brilliant golden. Useppa Island.

6. *Mollienisia latipinna* Le Sueur.

Local in polluted water with bottom of dark ooze. Useppa Island.

7. *Strongylura notata* (Poey). "Needle Fish."

A number of young examples without scales. Found on the surface in shoals. Useppa Island.

8. *Hyporhamphus roberti* (Valenciennes). "Bally-hoo." "Hound-fish."

When fresh end of mandible deep blood-red. Dorsal and anal lobes and most of caudal blackish, and former conspicuously contrasted with whitish bases. Sides of body and eye brilliant silvery-white. Back pale olive-green, each scale with broad dark olive submarginal streak. Pectoral grayish. Ventral white. Length 222 mm. Useppa Island.

9. *Hemiramphus brasiliensis* (Linné).

Ocean off Biscayne Bay. Although Jordan recently contends *H. balao* Le Sueur is distinct I have been unable to distinguish it among my collections.

I have seen this species, while in the Florida Keys in 1904, rise out of the water and with a peculiar sculling motion of the tail, all the time the fish appearing nearly vertical in the air, move along the surface a hundred feet or more. Mr. Hebard recently saw numbers of the preceding also rise out of the water, as his boat pushed on, and elevate their bodies about 60° and move off in similar manner.

for 50 to 100 feet. Sometimes they would leave the water completely, though only for very short intervals or spaces of about 4 to 8 feet. The whole performance is quite suggestive of flying-fishes.<sup>22</sup>

\*10. *Holocentrus ascensionis* (Osbeck). 11. *Mugil cephalus* Linné.

12. *M. curema* Valenciennes.

Six young in the Querimana stage from Useppa Island 18 to 20 mm. long, and having 10 branched anal rays. A larger example, also in the same stage or about 45 mm. long and which I assigned to *M. cephalus*<sup>23</sup> agrees. It is also likely that the one I identified as the young of *M. curema*<sup>24</sup> from Santo Domingo is really *M. cephalus*.

Mr. Hebard found the young mullets in very small schools, of about 5 to 20 individuals, at the surface. A small quadrate area of the dorsal portion of the back was out of the water, conspicuously shining silvery, though other parts of the body hardly noticeable. These fish dart forward, all together, in short jerks, and would not leave the surface unless greatly alarmed. When disturbed or scattered they reassembled in a few moments at the surface.

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| 13. <i>Menidia peninsulae</i> Goode and Bean. "Glass Minnow." Found in schools on sandy bottoms in the shoals. Useppa Island.           | 31. <i>Calamus proridens</i> Jordan and Gilbert.  |
| 14. <i>Caranx hippos</i> (Linné).   | 32. <i>Lagodon rhomboides</i> (Linné). "Pinfish." Useppa Island. Common in shoals, among weeds and under docks.   |
| 15. <i>Trachinotus falcatus</i> (Bloch).  | 33. <i>Archosargus probatocephalus</i> (Walbaum).   |
| 16. <i>T. carolinus</i> (Linné).  | 34. <i>Diplodus holbrookii</i> (Bean). "Sailor's Choice." Useppa Island. Locally with the grunts in deep water about docks.   |
| 17. <i>Centropomus undecimalis</i> (Bloch).   | 35. <i>Eucinostomus harengulus</i> (Goode and Bean). "Sand Perch." "Sand Brem." Useppa Island. These vernaculars also applied to the next, though the species not distinguished by the fishermen. Both were moderately common in shoals, particularly on sandy bottoms. |
| *18. <i>Epinephelus striatus</i> (Bloch).   | 36. <i>E. gula</i> (Valenciennes).  |
| *19. <i>E. maculosus</i> (Valenciennes).  | 37. <i>Cynoscion nebulosus</i> (Cuvier).  |
| 20. <i>E. morio</i> (Valenciennes).   | 38. <i>Bairdiella chrysura</i> (Lacépède). Useppa Island. Young examples, all showing 3 large spines at preopercle angle.   |
| *21. <i>Mycteroperca bonaci</i> (Poey).   | 39. <i>Sciaenops ocellatus</i> (Linné).   |
| 22. <i>M. microlepis</i> (Goode and Bean).  |   |
| 23. <i>Diplectrum formosum</i> (Linné). Biscayne Bay.   |   |
| 24. <i>Lutjanus griseus</i> (Linné). "Mangrove Snapper." Soldier Key and Useppa Island. Young, numerous under docks at latter locality. |   |
| 25. <i>L. synagris</i> (Linné).   |   |
| 26. <i>Hæmulon sciurus</i> (Shaw). Soldier Key.   |   |
| 27. <i>H. plumieri</i> (Lacépède).  |   |
| *28. <i>Bathystoma rimator</i> (Jordan and Swain).  |   |
| *29. <i>Anisotremus virginicus</i> (Linné).   |   |
| 30. <i>Orthopristis chrysopterus</i> (Linné). "Grunt." Useppa Island. Very abundant in deep water about docks.                          |   |

<sup>22</sup> Proc. U. S. Nat. Mus., 55, 1919, p. 397, fig. Havana.

<sup>23</sup> Proc. Acad. Nat. Sci. Phila., 1903, p. 744, fig. 1.

<sup>24</sup> L. c., fig. 2.

40. *Leiostomus xanthurus* Lacépède.  
 "Spot."  
 Useppa Island.  
 \*41. *Chelodipterus faber* (Broussonet).  
 \*42. *Pomacanthus arcuatus* (Linné).  
 \*43. *Angelichthys ciliaris* (Linné).  
 44. *Balistes vetula* Linné.
45. *B. carolinensis* Gmelin.  
 46. *Monacanthus hispidus* (Linné).  
 47. *Spheroides harperi* Nichols.  
 48. *Lactophrys tricornis* (Linné).  
 49. *Chilomycterus schæpfi* (Walbaum).  
 50. *Opsanus tau* (Linné).  
 Biscayne Bay.
51. *Rhombochirus osteochir* (Cuvier).

Head  $4\frac{1}{3}$ ; depth 8; D. XVIII—III, 22; A. III, 22; P. I, 22; snout  $2\frac{1}{2}$  in head measured from upper jaw tip; eye 7; maxillary 3; inter-orbital  $1\frac{1}{2}$ . Body slender in profile, depressed in front and moderately elongate, slender caudal peduncle compressed. Head width about  $1\frac{1}{4}$  its length. Snout broad, half long as wide. Eye small, high, hind pupil edge about midway in head length. Mouth broad, gape about half way to eye. Maxillary ends before eye slightly less than eye diameter. Upper teeth in 3 rows, inner largest, well spaced and fewest, median irregular, and very minute outer close-set, even, simple, conic, forming lashed or ribbed appearance, especially along each side of jaw within mouth. Outer upper teeth also extend on premaxillary, followed by 4 or 5 large well-spaced teeth on maxillary edge. Band of fine teeth in lower jaw, most pronounced on sides of jaw anteriorly but not evident posteriorly or at symphysis so none extend back beyond fine teeth on premaxillary. Broad band of minute vomerine teeth edged in front and anteriorly with row of larger teeth. Tongue narrow, free in front and covered with fine teeth. Gill-opening extends forward about opposite maxillary tip. Rakers I, 1+9 III, lanceolate, about half length of filaments. Skin smooth, apparently scaleless. Disk width about  $2\frac{1}{4}$  its length, which  $2\frac{1}{2}$  from snout tip to caudal base, laminae quite spinescent. Dorsal origin midway between twelfth disk lamina and caudal base. fin elevated from first dorsal ray. Anal inserted very slightly behind dorsal origin, similar. Caudal  $1\frac{2}{3}$  in head, hind edge concave and lobes convex, though lower slightly longer. Pectoral rhomboid, rays very rigid or stiff, fin rhomboid,  $1\frac{2}{3}$  in head. Ventral inserted directly behind pectoral base,  $2\frac{1}{4}$  in head. Color when fresh in alcohol largely pale to whitish on disk and variably over upper left side, including eye and most of pectoral. Pale area also gives off pale line down to vent and inside gill-opening. Iris whitish with pale yellowish tint. Though left pectoral largely white, except gray border, and basal blotch, right pectoral dull purplish-brown with pale inferior blotch. Dorsal and anal slaty-black or nearly whitish narrowly along bases. Caudal dusky to blackish medially, lower

lobe marginally pale gray, upper darker. Anterior to vent dark body color mostly purplish-gray, posteriorly brownish. Ventral neutral dusky with very narrow pale edge behind. Length 133 mm.

The above example of this rare fish was found on an adult *Istiophorus nigricans* captured in the Gulf Stream  $1\frac{1}{2}$  miles south of Fowey Rock Light, Florida, in March, 1919. It was secured for the Academy by Mr. Morgan Hebard. He tells me the *Istiophorus* was 6 feet 8 inches long and when hauled on board the *Rhombochirus* continued to adhere to the post-pectoral region of its host, remaining quiet. When pulled off by the tail it became quite active. Mr. Hebard also notes that in life the color had a smooth and immaculate mouse-brown appearance, strikingly marked about the pectoral, head and disk with whitish. While alive these markings were symmetrical, though now as described previously, the change took place immediately after death. In life the pectorals had conspicuous dark borders and pale centers.

Valenciennes figures the species from the sea of the Antilles, showing the dorsal origin about midway between the sixth dorsal lamina and the caudal base, color largely uniform brownish with neutral tints or only disk pale, pectoral brown, ventral pale or gamboge and the eye much smaller than in my example.<sup>35</sup> Poey examined several examples which he named *Echeneis tetrapturorum*<sup>36</sup> up to 300 mm. long. As may be inferred, Poey's examples were all from *Tetrapturus*, while the present one seems to indicate a new host for the species.

<sup>35</sup> Cuv. Règne Animal (Ed. Ill.,) 1839, 312, Pl. 108, fig. 3.

<sup>36</sup> Mém. Hist. N. Cuba, II, 1858, p. 256, Pl. 18, fig. 2 (pectoral fin). Cuba.

**SYNONYMIC STUDY ON THE MOLLUSKS OF THE DEPARTEMENT  
DES ALPES-MARITIMES MENTIONED BY ANTOINE RISSO<sup>1</sup>  
WITH NOTES ON THEIR CLASSIFICATION**

By COMMANDANT E. CAZIOT

(TRANSLATED, AND WITH INTRODUCTORY NOTE, BY WILLIAM HEALEY DALL)

[The work of Risso is important, apart from its monographic character, for the reason that the author introduced many new generic and specific names, thus modifying the current nomenclature. During a brief visit to Nice in 1906, I found that the Risso collection was still in the possession of his heirs, and not in any public museum. As criticisms of subsequent authors indicated that several of the species upon which some of Risso's new names were founded had been incorrectly determined by him, it was highly important that their identity should be fixed. No living author is more familiar with the landshells of the district than the present distinguished Director of the Municipal Museum at Nice, and, after some correspondence, he kindly consented to summarize his conclusions from a study of the original collection, now unfortunately not in the best state of preservation. The shells of the Risso collection had originally been mounted in cartons, but in the course of more than ninety years many of them have been detached and others lost through the natural accidents to which such a collection is liable when not in expert custody. Hence a certain number of identifications are irretrievably lost. For such as still remain practicable students of the subject will be under deep obligations to the author of this paper. W. H. D.]

Risso is the first author to publish a general review of the land and fresh-water shells of the Maritime Alps.

His work has been the subject of a review by two critics, first, that of Gabriel Mortillet, who, in 1851, in the *Bulletin de la Société d'Histoire Naturelle de Savoie* (p. 72), said that the descriptions of shells by Risso left much to be desired; and secondly by Bourguignat,

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<sup>1</sup> *Histoire Naturelle des Principales Productions de l'Europe Méridionale, et Particulièrement de celles des Environs de Nice et des Alpes Maritimes*, vol. IV, Paris, Levraut, 1826. 8° pp. 440, pl. 11.

ten years later, in his *Étude Synonymique sur les Mollusques des Alpes-maritimes*. He treated the author with great severity, calling him a writer without judgment, an indefatigable but absurd innovator, etc.

It is evident that Antoine Risso was imperfectly acquainted with the works of his predecessors, and that he attempted to cover too wide a field, including plants, crustaceans, fish, mammals, birds, geology, mineralogy, etc., etc.

One cannot be a universal naturalist. If one desires to produce authoritative work, it is necessary unless one is a genius of the first order, to study but a single chapter of natural history, since the field is too vast. The division of work is necessary even to those of exceptional intelligence, and the subdivision of that which is now regarded as a specialty will naturally be necessary in the future.

In his synonymical study Bourguignat has used a criticism too bitter and acrimonious. It is not the language which a master should employ with regard to the errors of his predecessors. Draparnaud, the creator of French conchology, said truly that he who opens the way has a right to indulgence, even if he has done poorly; to glory if he has done well; and to gratitude when his successor has done better than he. Risso was not conscious of the errors that he committed. He must have been satisfied of the correct determination of his species, since in the introduction to his fourth volume he realizes the importance of this point in citing the words of Cuvier that "the precise determination of species and their distinctive characters forms the fundamental basis on which all the investigations in natural history should rest."

The Risso collection remains in the possession of the son of the nephew of the great naturalist at his estate of St. Roch at the gates of Nice. It is visited by passing naturalists who experience serious disappointment on discovering the absence or loss of many specimens mentioned and described as new by Risso.

At the death of the eminent naturalist the person charged with the care of his collections at St. Roch was, I have been told, completely ignorant of natural history; she made grave mistakes; mixed exotic and native species, many among them bear no indication of habitat, and a great number have become detached from their cartons and scattered through the cases. It is impossible now to recognize the greater part of the specimens which served Risso as types.

In his introduction to the fourth volume Risso states in a final note (p. VII) that his new genera and species of shells will be de-



posited in the Muséum d' Histoire Naturelle, in order that zoologists may assure themselves of the exactitude of his observations.

However, none exists in the Museum at Nice, nor in the Museum at Turin, and I believe it is certain that none is found either at Genoa or Paris. The study of his species can therefore only be undertaken in the private collection itself.

In the following pages I have noted the conclusions which have resulted from my study of the specimens, and the differences of opinion which I have with his previous eminent critics. The synonymic study which I have undertaken before publishing the Fauna of the Terrestrial and Fluvial Mollusks of the Principality of Monaco and of the Département des Alpes-Maritimes, in 1910, relates only to this part of the volume on Conchology. In the present notes I review only the species mentioned by Risso, and in the order in which they were placed by him.

In taking up the slugs I can make but few notes because the specimens, long since deprived of alcohol, are absolutely dessicated and indeterminate.

The numerals following the names are those of the original pagination in Risso's fourth volume.

*ARION LINEATUS* Risso (55). Bourguignat asserts that this is the *Arion hortensis* of Férussac, since Risso's species differs only from that of Férussac by its lateral zones of a more orange tint. This is not sufficient to establish their identity. Pollonera, in his *Recensement des Arions de la Région Paléarctique*, has retained Risso's species, as that author specifies that his *Arion* had blackish eyes and the foot of a dirty gray, and this color does not agree with that of *A. hortensis*. It is probable, however, that Risso confused several species under one name.

*LIMAX ANTIQUORUM* (Fer.) Risso (55). Bourguignat states that it is by an error that Risso said of this slug "clypeus levi," because the entoconch of this species is always concentrically striated. In their monograph of Italian limaces M. M. Lessona and Pollonera have demonstrated that this *Limax antiquorum* (pars) Férussac<sup>2</sup> is a synonym of *Limax maximus* (pars) Moquin Tandon, and also a synonym of *Limax cellarius* d'Argenville. Therefore Risso's species should be called by this name. Under the name of *antiquorum* Férussac has moreover united in a single species all the large limaces, *cellarius*, *cinereo-niger*, and their varieties.

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<sup>2</sup> Hist. Moll. 1819, p. 4, figs. 2, 7 and 8.

**LIMAX GAGATES** (Drap.) Risso (55). This is the true *gagates* of Draparnaud, the type of the genus *Milax* Gray.

**LIMAX VARIEGATUS** (Drap.) Risso (56). Bourguignat considers this slug as merely a variety of *Limax maximus* Linné, or *L. cinereus* (pars) Müller. The *L. maximus* of Linnæus is identical with the above mentioned *L. cellarius*.

**LIMAX MARGINATUS** (Drap.) Risso (56). Bourguignat regards this as the *L. marginatus* of Müller (1774) and Draparnaud. The *Limax martinianus* Bourg. (1869) is certainly one of the numerous varieties of *L. marginatus*.

**LIMAX AGRESTIS** (L.) Risso (56). This is recognized by Bourguignat as correctly determined. The *Limax niciensis* and *mentonicus* mentioned by Nevill<sup>3</sup> from the Maritime Alps are mere varieties of *L. agrestis*, which in Liguria as in Tuscany varies much in coloration and pattern.

**LIMAX CARINATUS** Risso (56). The brief description given by Risso has been completed by Bourguignat. The species is common in Liguria. It should not be confused with *Limax carinatus* (Leach, 1820), Turton, 1831, renamed by Férussac *L. sowerbyi*, the validity of Leach's publication being doubtful, though the name was current among authors 1820-23. There is also a *Limax carinatus* of Orbigny, 1839, which has been renamed *polyptychus* by Bourguignat, 1859.

This species should be included under the genus *Milax* Gray (better known as *Amalia* Moquin Tandon) as pointed out by Bourguignat, 1854, and B. B. Woodward, 1903. The anatomical differences from *Limax* have been exposed by Sordelli in his Anatomy of *Limax etruscus* Issel.<sup>4</sup>

**LIMAX LINEOLATUS** Risso (57). I have not discovered this species in the district. The original specimen is decayed beyond recognition.

**ORIS FERUSSACI** Risso (57). A marine slug of the family Onchidiidae according to Bourguignat. Risso describes its habitat as in moderate depth of water on muddy bottom. Not later recognized.

**TESTACELLUS BISULCATUS** Risso (58). Mortillet united this species with *T. haliotidea* Draparnaud, but since the latter does not

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<sup>3</sup> *Landshells of the Neighborhood of Mentone*, Proc. Zool. Soc. London for 1880, p. 103.

<sup>4</sup> Bull. Mal. Ital. 1872, p. 5.

occur in the district nor in the Département du Var. Bourguignat has retained the name as valid. It has since been reported from Morocco at Tangier by M. Hesse, in 1880.

*TESTACELLA EPISCIA* Bourguignat. This species described from the entoconch alone, no longer exists in the Risso collection.

*SUCCINEA MAJOR* Risso (59). The carton containing specimens of this species also includes one specimen of *Succinea putris* L., which must have come from elsewhere, as it is not known from the Alpes-Maritimes, nor even from the adjacent Département du Var.

The dimensions given by Risso for this species are 18.0 mm. in length and for the *S. elegans* 10.0 mm. The two forms are identical, and the species is common in the environs of Nice, varying from ten to eighteen millimeters in length.

The species was subsequently named *S. corsica* by Shuttleworth, but the name *elegans* has generally been adopted for it. The name *major* does not appear in Clessin's Nomenclator of Pfeiffer, who referred both of Risso's species to varieties of *S. putris* L.

*SUCCINEA ELEGANS* Risso (59). See remarks under the preceding. In 1842, Pfeiffer named a species of *Bulimulus*, *Succinea elegans*.

*HELICOGENA POMATIA* (L.) Risso (60). This species exists in the Alpes-Maritimes, but only in the high valleys of the Var, of the Vesubie, and of the Tinée.

*HELICOGENA NEMORALIS* (L.) Risso (60). Common in the Département. It has not varied in form since the middle Pleistocene.\*

*HELICOGENA CANDIDISSIMA* (Drap.) Risso (61). Common in the Alpes-Maritimes below the altitude of 1200 meters. Risso's variety is a scalar form.

*HELICOGENA SPLENDIDA* (Drap.) Risso (61). Risso says that this species lives on the hills about Nice. He must have confused it with *H. niciensis* of Férussac. The *H. splendida* has not crossed the Var and I have found no trace of it in the numerous quaternary deposits of this region. It does exist on the right bank of the Var, locally, at the extreme limit of the Département. Risso gives to specimens which he had collected or which had been given to him a diameter of 10 mm., there are none of this size in his collection.

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\* See: Caziot et Maury, *Tableau des Mollusques terrestres et fluviatiles du Pléistocène de la Ligurie occidentale et du Département des Alpes-Maritimes*, Journ. de Conchyl., vol. 57, p. 317, 1909.

The smallest specimens I have seen come from Spain or from the Moorish range, and have not over 12 mm. diameter and 8 mm. height.

*HELICOGENA NICOEENSIS* (Fér.) Risso (61, figs. 19, 20). Férussac described a *Helix* under this name in 1822, from Nicæa, Greece, near Mount Olympus. His use of the form *niciensis* for the shell from southern France was later. The former was regarded by Pfeiffer as a variety of *Helix desertorum*, which is perhaps the reason why no one has proposed a new name for the French shell.

*HELICOGENA LIBELLULA* Risso (62, f. 21). This is the yellow mutation of *H. nemoralis* without bands.

*HELICOGENA IMPERFECTA* Risso (62). A yellow variety of *H. nemoralis* with the bands indicated by rows of imperfectly connected brown spots or flecks.

*HELICOGENA OLIVACEA* Risso (63). Bourguignat considers that Mortillet erred in regarding *H. olivacea* as a variety of *H. nemoralis*. He considers it to be the *H. sylvatica* of Draparnaud. In this I agree with him, although *H. sylvatica* lives only in Italy on the confines of the Department, near the Col de Tende.

*HELIX ASPERSA* (L.) Risso (63). Very common.

*HELIX VERMICULATA* (L.) Risso (63). Very common.

*HELIX RUGULOSA* Risso (64). This species is really *H. vermiculata* variety *concolor* Cristofori and Jan. Bourguignat referred it to *H. lactea*, which does not occur in the region under consideration. Cantraine regarded it erroneously as a synonym of *H. muralis* Müller, which also does not inhabit the Department.

*CANTAREUS NATICOIDES* (Drap.) Risso (64). This is the *Helix aperta* Born, very common at Nice.

*HELICODONTA OBVOLUTA* (L.) Risso (65). *Helix obvoluta* Müller. Common.

*HELICIGONA LAPICIDA* (L.) Risso (66). This species seems to be confined to the mountainous part of the right bank of the River Var.

*HELICIGONA CORNEA* (L.) Risso (66). This is only found in the Département du Var, localized at Moissac and, according to Bérenquies, rarely. A variety of it is found in the Alpes-Maritimes.

*HYGROMIA CINCTELLA* (Drap.) Risso (67). This is correctly identified by Risso.

**HYGROMIA FOLLICULATA** Risso (67). This is correctly identified by Mortillet and Bourguignat with *Helix ciliata* Venetz. It is found in the environs of Nice, localized to the north of St. André.

**HELICELLA ALGIRA** (L.) Risso (68). This is very common in the Alpes-Maritimes below 1500 meters altitude and in the Var below 900 meters. It never exceeds 45 mm. in diameter.

**HELICELLA ALBELLA** (L.) Risso (68). The *H. albella* Draparnaud is identified with the *Helix explanata* Müller. It is now found only on the right bank of the Var, very rarely, and seems to be on the way to extinction. I have not found it in the quaternary beds of the region.

**HELICELLA CONICA** (Drap.) Risso (68). This is really *Helix cornea* Draparnaud, broken and bleached by the loss of its epidermis. It was referred to *H. variabilis* by Mortillet, and to *H. lineata* Olivi, by Bourguignat. I have shown elsewhere that the latter species does not exist in France.

**HELICELLA ELEGANS** (Drap.) Risso (69). Very common in the lowlands near the sea. Risso's specimens belong to *Helix scutula* Cristofori and Jan.\* Bourguignat considered this species as a synonym of *Helix terrestris* Pennant, but according to St. Simon, *terrestris* and *elegans* are distinct species.

**HELICELLA RUPESTRIS** (Drap.) Risso (69). I have not found this species near Nice, but it occurs on the Italian frontier on the banks of the Roya, and also at the entrance to the gorges of the Cians.

**HELICELLA RADIATUS** (L.) Risso (69). I have seen on his carton only a slightly flattened variety of *Helix rotundata* Müller. Bourguignat however regarded the species as a somewhat elevated variety of *Helix apicina* Lamarck.

**HELICELLA SOLARIUM** Risso (70). This is really *Helix elegans* Draparnaud, already referred to.

**HELICELLA MAMILLATA** Risso (70). This is as remarked by Bourguignat, the *Helix lapicida* Linné, which is now confined to the right bank of the Var, but which I have found fossil in the quaternary deposits of Cape Martin near Mentone.

**HELICELLA VARIANS** Risso (70). On the carton labelled *varians* I find two *H. ciliata* Venetz, and a very young *Helix rotundata*

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\* Cf. Caziot, Bull. Soc. Zool. de France, XXXIII, No. 10, 1908.

Müller. It is curious that Bourguignat should have considered them as young whitish specimens of *H. cespitum* Müller. The latter is however common near Nice and in the quaternary deposits of the region.

*HELICELLA ERICETORUM* (L.) Risso (71). Risso's specimens represent, not the *H. cespitum* as claimed by Bourguignat, but *H. mantinica* Mabilie of the group *Cespitana*, a rather rare species in the Alpes-Maritimes. The *H. ericetorum* does not occur in this region where it is at present replaced by the *H. ericetella* Jousseau, which is smaller, less depressed, with a larger umbilicus.

*HELICELLA VARIABILIS* (Drap.) Risso (71). Bourguignat considered that there were two species on Risso's carton, *H. variabilis* of Draparnaud and *H. submaritima* of Desmoulins. I have established the truth of the first identification but the second is not correct, it being the *H. pilula* Locard, which also belongs to the group of *variabilis*.

The *H. submaritima* Desmoulins' has been sent to me from various places in France, always in the neighborhood of the ocean: Isle de Ré, Brest, Honfleur, Royan, etc. It is very distinctly marked by its form and small size, hardly greater than that of *H. striata* Draparnaud. It is very distinct from *H. maritima* and *pyramidata* and does not occur in the Risso collection.

*HELICELLA NITIDA* (Drap.) Risso (72). Mortillet wrongly identifies this species with the *Zonites (Hyalina) nitens* Michaud. For Bourguignat Risso's specimens constitute a new species close to *Z. cellarius* Müller. The differences are very slight.

*HELICELLA FASCIATA* Risso (72). Young specimens of *Helix cespitum* Draparnaud.

*HELICELLA FERRUGINEA* Risso (72). This is the *Helix lenticula* Férussac, which is found in the neighborhood of Nice.

*HELICELLA HISPIDA* Risso (72). This is the *Helix hispida* Linné, very common on all the prairies.

*HELICELLA HISPIDULA* Risso (73). This is *Helix apicina* Lamarck.

*HELICELLA PREVOSTIANA* Risso (73). A variety of *Helix hispida* Linné.

*THEBA* (Leach Ms.) Risso (73). *THEBA PISANA* (L.) Risso (73). Very common on all the shores.

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<sup>1</sup> *Suppl. Moll. Gironde*, p. 6, 1851.

THEBA PYRAMIDATA (Drap.) Risso (74). Risso's specimens belong to the *Helix subpyramidata* Caziot. The typical *pyramidata* is localized to the north of Villefranche-sur-Mer.

THEBA CONSPURCATA (Drap.) Risso (74). Correct.

THEBA CARTHUSIANA (Drap.) Risso (74). Correct.

THEBA CARTHUSIANELLA (Drap.) Risso (75). Bourguignat remarks that *H. carthusiana* Müller (1774) should not be confused with Draparnaud's species of the same name (1805) which, he says, should be referred to *H. cantiana* Montagu. I regard this as an error. The *H. cantiana* is a northern species of which the variety *minor* has a striking analogy with the *H. rubella* Risso, while the *H. carthusianella* of Draparnaud is a minor variety of his *H. carthusiana*.

THEBA CEMENELEA Risso (75). Two species were placed by Risso in this carton, the second of which is *H. carthusiana* Müller.

THEBA RUBELLA Risso (75). The specimens agree well with his description.

THEBA CHARPENTIERA Risso (76). This is a dirty white or yellowish ash colored variety of the *Helix rubella*.

THEBA MERIDIONALIS Risso (76). Young specimens of *Helix vermiculata* Müller.

THEBA LUCOSTOMA Risso (76). Young examples of *Helix pisana* Müller.

COCHLICELLA VENTROSA (Drap.) Risso (77). This species is synonymous with *Helix acuta* Müller.

COCHLICELLA TENUIS Risso (77). Smaller and darker specimens of the last mentioned.

COCHLICELLA MERIDIONALIS (Drap.) Risso (78, fig. 26). Very large specimens of *Helix barbara* Linné, which Bourguignat has confused with *H. acuta*.

COCHLICELLA TURRICULA (Drap.) Risso (78). These specimens have disappeared from the collection. According to Bourguignat they were smaller banded specimens of *H. barbara*.

BULIMULUS RADIATUS (L.) Risso (78). The *Buliminus radiatus* is found locally, in the northern part of the Department.

RUMINA Risso (79). RUMINA DECOLLATA (L.) Risso (79). This is the *Bulimus decollatus* of Bruguière.

COCHLICOPA LUBRICA (L.) Risso (80). The *Bulmus lubricus* of early writers.

FERRUSSACIA Risso (80). FERRUSSACIA GRONOVIANA (Fér.) Risso (80). This has been described and figured by Bourguignat in his "*Étude Synonymique*," p. 41, pl. 1, figs. 8, 9, 10. The double "r" in the name is doubtless a misprint.

FERRUSSACIA SAYEA Risso (80). Risso states that this shell is sinistral, but Bourguignat and I have shown that it is dextral and belongs to the genus *Cæcilianella*.

ACICULA Risso (81). ACICULA EBURNEA (Müll.) Risso (81). A *Cæcilianella* which has been described and figured by Bourguignat, p. 43, pl. 1, figs. 20, 21, 22.

VEDIANTIUS Risso (81). VEDIANTIUS ERISTALIUS Risso (82, fig. 24). The specimen figured by Risso is an indeterminable *Férussacia*.

ORBITINA Risso (82). ORBITINA INCOMPARABILIS Risso (82, fig. 23), and ORBITINA TRUNCATELLA Risso (82, fig. 25), are founded on immature specimens of *Rumina decollata*.

CRENEA Risso (83). CRENEA VITREA Risso (83). Founded on immature specimens of an indeterminable species of *Cæcilianella*.

SARAPHIA Risso (83). SARAPHIA UNIPPLICATA Risso (83), SARAPHIA UNIDENTATA Risso (84), SARAPHIA BIDENTATA Risso (84), and SARAPHIA PLEYFELIA Risso (84), have disappeared from the collection.

SARAPHIA TRIDENTATA Risso (84). This is a species of *Carychium* which has been figured by Bourguignat (pl. 1, figs. 27, 28), who has given a full description with synonymy.

CLAUSILIA CINEREA (Drap.) Risso (85). This is the *Pupa similis* of Bruguière.

CLAUSILIA BIDENS (L.) Risso (85). This is the *Clausilia solida* Draparnaud, very common in the district, while the *C. bidens* of Linné does not occur there.

CLAUSILIA CHARLOTIA Risso (86, fig. 22). This is *Pupa variabilis* Draparnaud.

CLAUSILIA CRENULATA Risso (86). Mortillet has erroneously compared this with *C. plicatula* Draparnaud, but it is more properly associated with *C. rugosa* Draparnaud, though distinct. The later



*C. crenulata* Rossmässler (1835) from Dalmatia was renamed by Bourguignat *C. thamnophila*. The latter author, in his monograph of the Clausilias of France, has however figured *C. pyrenaica* of Charpentier under the name of *crenulata* (figs. 11, 12) in which error he has been followed by Locard in his "*Mollusques de France*" (p. 287). I have described the varieties of this species in my "*Faune des Alpes-Maritimes*"

CLAUSILIA MARCELIA Risso (86). This has been referred to *C. parvula* Studer, by Mortillet, to *C. nigricans* Pulteney, by Bourguignat and I prefer the name of *C. bidentata* Ström, given in 1765,<sup>\*</sup> while Pulteney's "*Dorset Catalogue*" dates only from 1799.

CLAUSILIA HETEROSTROPHA Risso (87) and CLAUSILIA MACLURIANA Risso (87), are merely varieties of *C. solida* Drap.

CLAUSILIA POLITA Risso (87, fig. 36). This is a good species. Bourguignat referred it to *Pupa multidentata* Moquin Tandon (1855), which is identical with *Turbo multidentatus* Olivi, 1792, but the characters are different and the name *polita* should be retained.

PEGEA Risso (88). PEGEA CARNEA Risso (88, fig. 29). This is a Tunisian *Férussacia*, given to Risso as coming from the environs of Nice. It probably was brought to the port with grain from Tunis which at that epoch was unloaded at Nice. Bourguignat has redescribed and figured it.

JAMINIA (Leach Ms.) Risso (88). JAMINIA MUSCORUM (Drap.) Risso (88), and JAMINIA MARGINATA (Drap.) Risso (89). These two species are the same thing, namely *Pupa umbilicata* Draparnaud (= *Pupa cylindracea* DaCosta). Bourguignat erroneously identifies the *J. muscorum* Risso with *Turbo muscorum* of Linné and Carl Pfeiffer.

JAMINIA EDENTULA (Drap.) Risso (89). This species exists at present in the northern part of the Department. It is a *Buliminus*.

JAMINIA SECALE (Drap.) Risso (89). This is *Pupa secale* Draparnaud.

JAMINIA TRIDENS (L.) Risso (90). This is *Helix tridens* of Müller.

JAMINIA GRANUM (Drap.) Risso (90). *Pupa granum* Draparnaud.

JAMINIA SULCULATA Risso (90). A broken and unidentifiable species of *Pupidae*.

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<sup>\*</sup> Trondhjems Skrift., III, p. 376, pl. 6, fig. 7.

JAMINIA TRILAMILLATA Risso (91). No longer exists in the collection.

JAMINIA HETEROSTROPHA Risso (91, fig. 31). From the figure and description this is certainly the *Bulimus quadridens* of Bruguière, but the specimens in the collection now bearing the label of *J. heterostropha* are *Pupa lunatica* of Jan.

JAMINIA QUINQUE LAMELLATA Risso (91). This is *Pupa (Torquilla) similis* of Bruguière.

JAMINIA SEPTEM DENTATA Risso (91). *Pupa avenacea* Bruguière.

JAMINIA HEPTODONTA Risso (92). Not now to be found in the collection.

JAMINIA MULTI DENTATA Risso (92). I have determined this to be identical with *Clausilia polita* Risso, (= *Pupa polita*).

JAMINIA NISO Risso (92). A variety of *Pupa quadridens* Müller.

AURICULA MYOSOTIS (Drap.) Risso (93). *Alexia myosotis* Mörch.

PYRAMIDELLA GRACILIS (Brocchi) Risso (93), and PYRAMIDELLA CARINATA Risso (94). These two fossil species I leave without comment.

ANCYLUS LACUSTRIS (Müll.) Risso (94). The *Ancylus* which is actually in the collection is the *A. gibbosus* Bourguignat, common at Nice. But Risso's description does not accord with the specimens of the carton labelled *lacustris*. Bourguignat has fully discussed the case in his synonymical study and figured the shell.

LYMNEA PEREGER (Müller) Risso (95). Correct.

LYMNEA AURICULA Risso (95). *Limnæus vulgaris* Carl Pfeiffer.

LYMNEA MINUTA (Drap.) Risso (95). The carton contains a mixture of *L. truncatula* and young *L. palustris* Müller.

LYMNEA LEACHIANA Risso (95, fig. 32). *Lymnæa palustris* Müller.

LYMNEA LABROSA Risso (96). The shell described by Risso is apparently no longer in the collection. The carton is occupied by *Physa fontinalis*, which is not a native of the Department and does not agree with Risso's description.

PHYZA FONTINALIS (L.) Risso (96). This is *Physa subopaca* Lamarck, which is no longer found in the Department.

PHYZA HYPNORUM (L.) Risso (96). This species is rare in the Department.

**PLANORBIS MARGINATUS** (Müll.) Risso (97). This is *Planorbis submarginatus* Cristofori and Jan. and, according to Bourguignat, *Helix complanata* Linné (var. B.).

**PLANORBIS CARINATUS** (Müll.) Risso (97). Correct.

**PLANORBIS SPIORBIS** (L.) Risso (97). Very poor specimens which might be *P. spirorbis* Linné, or *P. albus* Müller.

**PLANORBIS VORTEX** (Müll.) Risso (98). Correct according to Mortillet, but the shell has now disappeared from the collection.

**PLANORBIS NITIDUS** (Müll.) Risso (98). The specimens in the collection belong to two species, *P. rotundatus* Poiret, and *P. vortex* Müller. I have not found *P. nitidus* in the Alpes-Maritimes.

**PLANORBIS CRISTATUS** (Drap.) Risso (98). Correct.

**PLANORBIS RETICULATUS** Risso (98). No longer in the collection. Moquin Tandon confuses it with *P. albus* Müller, but it is not probable that he was able to examine the type before its disappearance. Risso queries its relation to that species.

**BITHYNIA** Risso (100). This name was spelled *Bithunia* by Gray in 1821 when he applied it to an undescribed new species (*B. ventrosa*), but in 1824<sup>\*</sup> he states that *Helix tentaculata* is the type and names Prideaux as the author of the genus. It is very probable that the English naturalist, Dr. Leach, communicated the name to Risso when he came to pass the season at Nice in 1820. Many authors write *Bythinia*, deriving the name from the Greek word signifying "those who live at the bottom of the water."

**BITHYNIA JACULATOR** (Müll.) Risso (100). This is the *Helix tentaculata* Gmelin, very common in the Department.

**BITHYNIA MERIDIONALIS** Risso (100, fig. 28). *Amnicola similis* (Drap.).

**VALVATA PLANORBIS** (Drap.) Risso (101). Bourguignat notes three species in this carton, *V. piscinalis* Férussac père, *V. spirorbis* Draparnaud, and a species near *V. cristata* Müller. The latter has never been announced from the Alpes-Maritimes.

**VALVATA MINUTA** (Drap.) Risso (101). Extremely young specimens of *Bithinia tentaculata* Linné.

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\* Phil. Mag. & Journ., lxiii, 1824, p. 277.

VALLONIA Risso (101). If the circulation of Leach's proof sheets between 1820 and 1823 constituted publication, his name *Zurama* would take precedence of *Vallonia*, but this view has not generally been accepted and is not in accordance with the international rules for nomenclature. There seems to be no doubt, however, that the proof sheets were communicated to several of Leach's correspondents and some of his names thus came into use before the effectual publication of his manuscript by Gray in 1852.

VALLONIA ROSALIA Risso (102, fig. 30). Under this name Risso included, as did many other naturalists before and later, *Helix pulchella* and *H. costata* of Müller, which are now accepted as distinct species.

LEACHIA Risso (102). The name *Leachia* had already been applied to a cephalopod by Lesueur in 1821.

LEACHIA VIRIDESCENS Risso (102, fig. 35), LEACHIA CORNEA Risso (102, fig. 33), LEACHIA VITREA Risso (103), and LEACHIA LINEOLATA Risso (103). These four species are very puzzling. Bourguignat was uncertain, and only gave a decided opinion in regard to *L. lineolata* which he regarded as the *Cyclostoma patulum* of Draparnaud (var. A) a species of *Pomatias*. Gustave Dollfus believed that Risso had in hand the *Hydrobia acuta* (Draparnaud), and that the first two of his species should be united, differing only in color. The third species, as Locard has admitted, may be the *Belgrandia vitrea* (Draparnaud). I think after an examination of these little shells that Dollfus is right.

CYCLOSTOMA ELEGANS (L.) Risso (103). Correct.

CYCLOSTOMA AFFINIS Risso (104). Risso's carton carries both *C. elegans* and *C. sulcatum* Draparnaud. I have only found this species, living, on the right bank of the Var between Mougins and Antibes, but apparently on the road to extinction. It occurs fossil in the quaternary deposits of the region.

CYCLOSTOMA OBTUSUM (Drap.) Risso (104). Very young specimens of *Cyclostoma sulcatum* Draparnaud.

CYCLAS VITREA Risso (338). This is *Pisidium casertanum* Poli, according to Bourguignat.

CYCLAS AMNICA (L.) Risso (338). *Pisidium amnicum* of authors.

Having passed in review all of Risso's fresh-water and terrestrial species, it should be clearly understood that he had made known

only a small portion of the fauna of the Department, which is certainly one of the richest and most interesting in France, giving asylum on the plains and lowlands near the coast to mollusks requiring a warm habitat; while on the mountains and the high ranges species peculiar to cold and very cold regions find a congenial home.

## DIPTEROLOGICAL NOTES AND DESCRIPTIONS.

BY EZRA T. CRESSON, JR.

This paper is a collection of notes on, and descriptions of, North American Diptera, made at various times while working over material sent to the writer for determination. It may here be explained that the data within brackets, [ ], refer to the owners of the material in question.

## STRATIOMYIDÆ.

*Zabrachia magnicornis* new species.

Similar to *polita*, but differing in having the frons more curving, without the median longitudinal sulcus; the antennæ are much larger, the scutellum more strongly developed, and the legs darker.

♀. Black; antennæ brownish, appearing lighter from the dense, appressed, pubescence or minute granulations. Halteres white with stalk fuscous. Apex of femora, entire middle and hind tibiæ, tawny; apex of fore tibiæ, and tarsi, darker; middle and hind tarsi yellow. Wings hyaline. All pile white and appressed, sometimes appearing silvery. Ovipositor yellow. Frons not sulcate medianly, convex and distinctly protruding above. Antennæ typical but large, situated in the depressed portion of the face and lower frons; third joint nearly as broad as the frons, twice as broad as long; arista straight, two and a half times as long as third. Scutellum strongly convex and subtuberculate above. Stigma hardly twice as long as broad; discal and posterior veins colorless. Length, 3.5 mm.

*Type*.—♀; Alamogordo, New Mexico, June 6, 1902, (Viereck & Rehn), [A. N. S. P. No. 9192].

A male (2 mm. long) from the same locality may belong here, but in general appearance it seems as though it should be associated with *polita*. However, in the short stigma and third vein it suggests the present species. In this male the head is nearly round in profile. Antennæ dark tawny. All pile erect and white, otherwise similar to *polita*. Apices of all femora all tibiae and tarsi, yellow.

A small female (head wanting) seems to agree with this male in all respects as to color.

## EUPARHYPHUS Gerst.

The furcation of the third vein is apparently of no specific value; a female of *tetraspilus* from Aweme, Manitoba, Canada (E. Criddle,

June), has the furcation in one wing but not in the other. Perhaps *bellus* Loew is only a synonym of *tetraspilus* Loew. The extent of yellow, or even the presence or absence of such, on the scutellum is a variable character.

***Euparyphus quadrimaculatus* new species.**

I cannot remark on the relationship of this species on account of the lack of material in this genus. It runs, in Adams's table (*Kans. Univ. Quart.*, II, 28), to *crucigerus* Coq., or *atriventris* Coq., but the abdominal markings are different.

♀. Eyes bare. Head yellow, with occiput except orbits, ocellar transverse band, an orbital spot and a fine dash above antennæ on frons, and antennæ, black. Two brown facial stripes covered by the broad silver along orbits. Cheeks and lower post. orbits silvery. Mesonotum black, with yellow as follows: Two median irregular or interrupted stripes, originating from spot above humeri, but not attaining posterior margin; broad lateral margins including upper half of pleura, but interrupted above base of wings. Scutellum and spines, and halteres also yellow. All pile short and white. Dorsum of abdomen black; lateral margins, a large lateral spot confluent with margin on third segment, and smaller, similar spots on apical margin of fourth, entire fifth, and venter, yellow. Legs yellow, with fore tarsi, hind tibiæ above, four apical joints of middle and hind tarsi, black; base of middle and of hind tarsi white. Wings hyaline with veins and stigma yellow. Mostly micro-granulose. Frons with parallel orbits. Face not prominent at antennæ. Antennæ not longer than head, with first and second joints subequal. Scutellum short, two or three times as broad as long. Third vein short, not furcate; costal distance between stigma and third not longer than stigma, and hardly longer than discal cell; four posterior veins faintly distinct, the last arising near base of discal cell. Length, 4 mm.

*Type*.—♀; Alamogordo, New Mexico, June 6, 1902, (Viereck & Rehn), [A. N. S. P. No. 6202].

A male from Santa Clara County, California, June, (W. M. Giffard, No. 7), [Cal. Ac. Sci.], is similar but the upper pleural band is narrower.

**AOCHLETUS O. S.**

The discovery of two species evidently belonging to this genus, but having the eyes pilose, necessitates including other characters, or establishing the genus upon other than those used heretofore, especially in Williston's "Manual." Osten Sacken ("Biologia," i, 38)

was correct in recognizing the antennæ as holding the most important characters in this genus. Three species have been placed in the genus of which I have seen but one, although all seem to agree in the general form of the antennæ and in having the eyes bare. Both *cinctus* O. S. and *bistriatus* Will., are more or less yellow vittate on mesonotum. The former having the face and frons also yellow, while *obscurus* Coq. has the mesonotum entirely black and no yellow on the entire body, although somewhat fuscous beneath the antennæ. *Obscurus* also differs from the others in having two polished gibbous calli above the antennæ; the scutellar spines are short, closely approximate with tips curving up. The two species described below differ from all in having the eyes pilose.

The antennæ in this genus, typically, have the first and second joints short, subequal, about as long as broad, or somewhat longer; the third composing of six to eight closely united segments, of which the first three or four are as stout or stouter than the second joint, each about as broad as long, the last tapering to the slender apical segments which seem to vary in length with the different species, and are tipped with one or more minute hairs.

***Aochletus albopilosus* new species.**

This and the following species are apparently allied to *obscurus* Coq., but there are no calli on the frons and the scutellum is broader with well separated spines.

♂. Black; margin of abdomen, knees, and bases of tarsi brown. Halteres white. Eyes black pilose. Pile of ocellar tubercle black, of face black and white, erect. Frontal triangle, facial orbits and post. orbits with appressed white pile. Thorax and scutellum with erect white pile, and appressed silvery white tomentum, which on mesonotum leaves three longitudinal bare stripes appearing black. Abdomen with sparse erect pile and tomentum as on the mesonotum, leaving the bases of segments bare and black; venter likewise clothed. Legs sparsely white pilose. Head broader than high, and slightly higher than long. Eyes contiguous for nearly full length of frons from the prominent ocellar tubercle; line of demarcation of facets distinct and opposite antennæ. Face short, broad, convex, but not prominent. Antennæ situated slightly below middle of profile, as long as head; third joint more than twice as long as first two together, of about six segments. Thorax robust, slightly longer than broad. Scutellum broader than long, broadly truncate, with two long well separated spines. Abdomen round; lateral margins sharp and thin.



Legs slender, normal. Third vein furcate near tip; four posterior veins of which the last arises at base of discal cell. Discal cell as long as stigma. Length, 8 mm.

*Type*.—♂; Alamogordo, New Mexico, May 13, 1902, (Viereck & Rehn), [A. N. S. P. No. 6193].

***Aochletus nigropilosus* new species.**

Similar to *albopilosus*, but all erect pile black except a little on the face. Antennæ shorter and stouter, and the scutellum broader with the spines more broadly separated. Length, 9 mm.

*Type*.—♂; Sonoma County, California, July, [A. N. S. P. No. 6194].

***Neorondania scutellata* new species.**

♂. Black, slightly steel blue, shining; frontal triangle, first, second, and base of third antennal joints, scutellum and spines, apices of femora, yellow or tawny. Halteres and bases of tarsi, white. Eyes black pilose. All erect pile black except on occiput and lateral tufts on second abdominal segment. Otherwise marked with appressed white pile as follows: Face, especially the orbits, three mesonotal vittae interrupted at suture, supra-alar dash, posterior mesonotal margin, notopleural spot, pleura, lateral transverse spot on abdominal segments three and four, larger lateral spot on fifth, venter and more or less of femora and tibiae. Eyes (moistened) with three horizontal purple lines. Head hemispherical. Eyes contiguous. Face convex above, depressed below. Antennæ as long as head; first joint twice as long as second; third quadrate, three and a half times as long as first and second together. Scutellar spines as long as scutellum, of light color and long black pilose. Abdomen broadly rounded, minutely granulose discally, with distinct impressed sutures. Legs slender, but hind femora somewhat flattened and enlarged beyond middle. Wings brownish hyaline; stigma and cross veins below, faintly fuscus. Length, 8–10 mm.

♀. Similar, but eyes bare. Head entirely tawny; frons as wide as length of first and second antennal joints together. No erect black pile, but design of appressed white pile as in male.

*Type*.—♂; Costa Rica, (W. M. Gabb), [A. N. S. P. No. 6195].  
*Paratypes*.—4 ♀; topotypical.

***Actina canadensis* new species.**

This species is readily distinguished from *viridis* Say by the low situated antennae, which is also shorter and more robust than in that

species. It is further characterized by the dark scutellar spines and the longer stigma. The latter in *viridis* is but little longer than the discal cell and but half again longer than broad.

♀. Similar to *viridis* Say. Frons shining, black with slight greenish tinge, sparingly short white pilose. Face more shining, black with long white pile. Palpi black. Antennæ situated below middle of profile, so that the frons is twice as long as the face, black with basal annulus of third joint brownish and distinctly swollen. Thorax and scutellum shining metallic green, becoming black below, sparingly yellow pilose; spines of the latter also metallic colored. Abdomen shining black. Legs yellow, but fore coxæ and four apical joints of tarsi black. Wings brownish, veins darker; stigma about twice as long as discal cell, and twice as long as broad. Length, 6 mm.

Type.—♀; Aweme, Manitoba, Canada, July 24, 1911, (E. Criddle), [A. N. S. P. No. 6196].

#### TABANIDÆ.

##### *Silvius jonesi* new species.

In general appearance this interesting species does not suggest any affinity with *gigantulus* Loew, but more critical examination makes it reasonably certain that it belongs to a group including that species and is very distinct from any yet described, to my knowledge. It is much larger than that species and the abdomen has black or dark bases to all segments. The tibial and antennal characters certainly place this species in *Silvius*, although in general appearance it suggests some of those in *Pangonia*. The eyes are uniformly green when moistened.

♂. Black; antennæ except four black terminal annuli of third joint, palpi, abdomen except dark bases of dorsal and ventral segments especially towards apex of abdomen, femora except bases, bases of tibiae, tawny or brown. Halteres pale. Wings blackish, more intense along costa. Subopaque. Yellow pruinose above, becoming gray below. All pile on head and thorax yellow and rather abundant, also on the narrow apices of abdominal segments; the broad bases of the segments with appressed black pile, similar on venter. Femora with pale pile which on the tibiæ becomes darker. Pile on first antennal joint and base of palpi, yellow; on second, and apices of palpi, black. No mesonotal vittæ. No denuded areas on face. Proboscis not longer than head, and palpi is slightly more than half as long as proboscis. First antennal joint twice as long as second; third twice as long as first and second together; the

thickened basal annulus nearly broad as long, the following annuli together as long as the basal one. Neuration as in *gigantulus*. Length, 17 mm.

♀. Similar but frons twice as broad as width of antennæ, entirely pruinose. Mesonotum more grayish.

*Type*.—♂; Keddie, Plumas County, California, July 6, 1918, (F. M. Jones), [A. N. S. P. No. 6197]. *Paratype*.—1 ♀; topotypical.

#### LEPTIDAE.

##### *Arthropeas jonesi* new species.

Differs from *americana* Lw., and *magna* Johns., the other known species, in having the legs entirely black. In build resembling *magna*, with a median globose swelling on the face similar to that in *Chrysopila* and nearly visible in profile. *Jonesi* probably represents a distinct genus or subgenus.

♂. Black; antennæ, palpi, and halteres pale, also a small spot on humeri. All pile black and rather long and abundant, including the cilia of the white squamæ. Face, and sparingly on mesonotum, grayish pruinose. Wings blackish, becoming more intense along costa. Thorax and abdomen, shining. First and second antennal joints short, subglobose; third, three to four times as long as first two together, and broader than second, gradually tapering to a minutely truncated apex, bearing a few hairs, not a terminal style, composed of eight annuli, of which the basal and apical ones are longer and subequal. Fore tibiæ with one small apical spur, middle and hind ones with two each. Length, 13 mm.

*Type*.—♂; Keddie, Plumas County, California, June 6, 1918, (F. M. Jones), [A. N. S. P. No. 6198].

##### *Chrysopilus nudus* new species.

This species suggests *flavibarbis* Adams, but the mesonotum of the female is not velvety and the pile and tomen are not yellow.

♂. Black; stalk of halteres, tibiae and bases of tarsi, pale. Wings slightly brownish. Opaque, grayish. Mesonotum dorsum, broad bases of abdominal segments, brownish. All pile and tomen sparse and white. Antennæ bare. Eyes narrowly separated. First antennal joint shorter than second. Palpi long, falciform, white pilose. Branch of third vein originating opposite end of first vein. Length, 5 mm.

♀. Similar, but stouter. Frons broad and brownish medianly. Mesonotum with a broad median stripe and two large sublateral

spots brown. Hind femora sometimes pale. Branch of third vein originating before tip of first; anal cell closed before margin.

*Type*.—♂; San Jacinto, California, May 29, 1917, (E. P. Van Duzee), [Cal. Acad. Sci.]. *Paratypes*.—1 ♂, 2 ♀; topotypical.

***Chrysopilus dilatus* new species.**

Differing from all known species by the enlarged first antennal joint. Thus suggesting *Symphoromyia* but the arista is terminal and the anal cell is closed.

♂. Black; stalk of halteres, knees, tibiae and bases of tarsi, paler. Opaque. Blackish brown, with face, pleura below, and venter more grayish. Erect pile of ocellar tubercle, face, palpi, antennae, mesonotum, scutellum, sternopleura, fore coxae, and femora, black; of occiput, pteropleura, and abdomen, pale. Sparse toment on mesonotum, abdomen and femora, pale yellow or whitish. Wings hyaline; stigma brown. Eyes narrowly separated or contiguous. First antennal joint much enlarged, twice as long as second and third together, nearly as broad as long, with dense, long pilosity. Palpi long, falciform, densely long pilose. Anterior branch of third vein originating before tip of first vein. Anal cell closed before margin. Length, 6 mm.

*Type*.—♂; Berkeley Hills, Alameda County, California, April 11, 1908, (E. T. Cresson, Jr.), [A. N. S. P. No. 6199]. *Paratypes*.—2 ♂; topotypical.

**BOMBYLIIDÆ.**

***Exoprosopa fumosa* new species.**

This species suggests some of those belonging to *Poecilanthrax*. It belongs to the group, in this genus, having the second abdominal segment black tomentose. The wings are fumose with the cells in the inferior part of the wings sub-hyaline.

♀. Black; oral margin and scutellum, paler. Knob of halteres whitish. Pile black on: head, disk of mesonotum, scutellum, pectus, apex of abdomen. Yellow on: collar, lateral mesonotal margins, meso- and meta-pleura, lateral margins of abdominal segments 1-5. Tomen all yellow except dorsum of second abdominal and bases of third to fifth segments. All bristles black. Wings uniformly brown except subhyaline areas in: apex of marginal, apex of first submarginal, second and third submarginals, discal, second to fourth posteriors, anal, and axillary. (In other words, the veins traversing the subhyaline inferior portion of the wings are broadly clouded

with brown.) Style one half as long as third antennal joint. Face conical; epistoma narrow, pilose. Proboscis not protruding. Fore tibiae slender, bare; hind femora slender, with long bristles. First posterior cell open. Length, 9 mm. Wings, root to tip, 18 mm.

*Type*.—♀; Nogales, Sonoma, Mexico, August 12, 1906, (P. P. Calvert), [A. N. S. P. No. 6200].

***Exoprosopa jonesi* new species.**

Allied to *doris* O. S., but the antennae are entirely black, and the second band of the wings is more extensively developed towards the margin. In the paratype this band broadly attains the margin. The yellow tomentose design of the abdomen suggests *grata* Coq.

♀. Black; lower frons, face, scutellum, lateral abdominal margins, venter, femora, tibiae, bases of tarsi, tawny. Club of halteres pale. Wings with bases of first and second basals, anal, and axillary cells, hyaline. Bases of first submarginal, first posterior, discal, third and fourth posteriors, and more or less of apices of anal and axillary cells, infuscated. Second band of infuscation includes base of second posterior nearly to margin along the veins. Base of third submarginal also infuscated, but apex of marginal is hyaline. Pile black on: frons, face in part, first and second antennal joints, mesonotum; lateral margins of second and following abdominals slightly mixed with black, pale. Pile pale on face in part, collar, mesonotum laterally, pleura, coxae, lateral margins of first abdominal segment and venter. Tufts of white pile above and below roots of wings. All tomen yellow except silvery along orbits, and black on some parts of pleura and on apices of second to fifth abdominal segments; also medially almost to bases of third to fifth segments, becoming stronger on base of fifth. No white tomen on abdomen except some on venter, but that on the second segment is slightly paler than on the other segments. Tomen on legs yellow. Second antennal joint twice as long as first; third as long as first two together, long, conical; style rather thick and slightly flattened, a fourth to a third as long as third joint. First posterior cell open. Tooth of claws small. Length, 12 mm.

*Type*.—♀; Keddie, Plumas County, California, July 3, 1918, (F. M. Jones), [A. N. S. P. No. 6214]. *Paratype*.—1 ♀; topotypical.

These specimens were captured hovering over nests of a species of *Bembex*.

***Exoprosopa (Exoptata) ingens* new species.**

Similar to but much larger than *divisa* Coq. The pile of the mesopleura is mostly black as is also the tuft beneath the wings.

The legs are entirely black. The wing pattern is more extensively developed, and the cross veins not noticeably subhyaline.

♀. Black; frons and face, first and second antennal joints (third wanting), scutellum, second and third abdominal segments laterally, bases of ventral segments, tawny to rufous. Knob of halteres pale. Wings brown or grayish brown, hyaline as follows: apex of marginal cell to base of second submarginal, apex of first submarginal, entire second and third submarginal, apices of first to fourth posteriors, and large median area in discal. Somewhat subhyaline areas on the cross-veins. Opaque. Pile black on: frons, face, first and second antennal joints, mesonotum, humeri, notopleura, mesopleura below, pteropleura, lateral margins of second and following segments, apex of abdomen, fourth and following ventrals, and all coxæ. All bristles black. Pile yellow on: collar, upper mesopleura, lateral margins of mesopleura, scutellum laterally, propleura, sternopleura, and lateral margin of first segment. Pile white on roots of wings, and second and third abdominal segments. Tomen mostly yellow, but black on: legs, broad apex of second abdominal, narrow apex of third, all of fourth and fifth except basal angles, medianly on sixth and seventh, and fourth and following ventrals. Narrow base of second abdominal, yellow; broad base of, third especially laterally, whitish; second and third ventrals white. Posterior orbits whitish.

Structurally same as *divisa* (by comparison with my specimens of that species) but more robust. Length, 20 mm.

*Type*.—♀; Florence, Arizona, (C. F. Biedermann), [A. N. S. P. No. 6201]. *Paratype*.—1 ♀; topotypical.

***Anastoechus barbatus*.**

1877. Osten Sacken, Bul. U. S. Geol. Surv., iii, 252.

The species of this genus are easily separated from those of *Systoechus* by the thick, facial pile. Material before me consisting of 11♂, 14♀, from Long Island, N. Y., North Carolina, Texas, Colorado, and New Mexico, fall into two groups. One having the knob of halteres pale yellow, the other with the knobs black or brown. There seems to be no correlation of these characters with the difference in locality. The only two from the eastern Atlantic region have the knobs pale; others from Colorado and Texas have the same.

A male from Europe, determined as *nitidulus* Fab., has a distinct, dorsal median line of dense white tomen on the abdomen which is not present in any of the other males before me from the

above cited localities. As this character may be typical of *nitidulus*, we had better adhere to Osten Sacken's name for our form.

***Spogostylum vierecki* new species.**

Similar to *vandykei* Coquillett. Pile of face black, but a few pale hairs near oral margin, margins of mesonotum, and pleura mostly black. Thorax, scutellum, and abdomen with yellowish white tomen. The wings also differ from each other in their maculation.

♂. Black; tibiae, bases of tarsi, knob of halteres, lateral margins of abdomen, part of venter, and genitalia, tawny. Wings hyaline; basad of humeral cubital vein, middle spot in first basal, veins at bases of first, second and third submarginals, first and fourth posteriors, broadly clouded. Costa to tip grayish. Opaque; mesonotum slightly shining. Pile of head black, with slight mixture of pale along oral margin. Collar and pleural pile pale. Some stiff black hairs or bristles along margins of mesonotum, of scutellum, and on pleura at roots of wings. Pile of lateral margins of first abdominal segment white, of remainder of abdomen, black. Legs with black bristles. Tomen pale yellow on: head, thorax, scutellum, and legs. On second and following abdominal segments, nearly white, and dense. Three or four spots of black tomen on apical margins of second to fourth segments. Structurally normal of *Argyramoeba*, with veins connecting second and anterior branch of third veins; fifth vein between discal and third posterior cells with an angulation, sometimes with a small stump into latter cell. Length, 6-9 mm.

♀. Similar, but the tomen of abdomen is mostly yellow with the series of black spots more pronounced on other segments.

*Type*.—♂; Alamogordo, New Mexico, April 25, 1902, (Viereck & Rehn), [A. N. S. P. No. 6203]. *Paratypes*.—3♂, 6♀; topotypical, 7♂, 1♀; El Paso, Texas, April 4-5, 1902, (Viereck & Rehn).

**ANISOTAMIA Macq.**

1840. Macquart, Dipt. Exot., II, (1), 81.

Some confusion exists regarding the validity of this and *Ogcodocera* Macq. (1840). There is general agreement that the two may be synonymous, and for the present they had better be considered so. Becker<sup>1</sup> tries to separate them, but apparently, judging from an examination of his descriptions and table, he did not know either material or literature regarding these genera. *Anistomia* has priority

<sup>1</sup> 1913. An. Mus. Zool. Ac. Imp. Sci. St. Petersb. XVII, 421-502. 1912.

of two pages over *Ogcodocera* (= *Oncodocera* O. S., 1878) and so must be used for our species. Further study of material from all countries will probably result in a different nomenclature for our forms. North America has *Mulio leucoprocta* Wied. (1828), *Anthrax valida* Wied. (1830), and *Anisotomia fasciata* Will. (1901), now credited to this genus.

*Genotype*.—*Anisotomia ruficornis* Macq. (1840). [Coq. 1910].

#### EPACMUS O. S.

I should keep this genus separated, at least subgenerically, from *Aphoebantus* on account of the projecting face.

#### *Epacmus modestus* Loew?

1872. *Leptochilus modestus* Loew, Berl. Ent. Zeit., xvi, 77. (Cent. x, 40.)

A female from Alamogordo, New Mexico, May, (Viereck), apparently belongs to this species, but the bristles of the hind margin of mesonotum (not of postalar calli), and scutellum are black. Lower part of face is polished. Pile and tomen of occiput, pleura and venter, white; of mesonotum and scutellum, yellow. Scutellum not noticeably emarginated. Length, 8 mm.

#### *Epacmus pallidus* new species.

Similar to *modestus*, according to description, in having the eyes contiguous, but differs in having the palpi pale and lacking the black bristles or tomen on the abdomen.

♂. Black; oral margin, palpi, halteres, part of genitalia, tibiae, bases of tarsi, pale tawny. Wings clear, veins yellow. Opaque, with two polished swellings on apex of scutellum. All bristles pale. Pile except on ocellar tubercle, and tomen on thorax and abdomen, white or slightly yellowish. A dorsal, median transverse fascia of brown tomen on segments 2-5, not attaining lateral margins (absent in some specimens). Genital segments not tomentose. Eyes contiguous for about a distance equalling length of ocellar tubercle. Third antennal joint longer than first and second together, gradually attenuating to a rather truncate apex which bears a short style. Face projecting beyond second antennal joint. Proboscis projecting equal to length of antennae. Scutellum emarginated. Length, 4-5 mm.

♀. Similar but pile on frons above dark. Third antennal joint more slender apically.

*Type*.—♂; El Paso, Texas, April 5, 1902, (Viereck & Rehn), [A. N. S. P. No. 6204]. *Paratypes*.—3♂, 1♀; topotypical.



**ECLIMUS** Loew.

1844. Loew, Stet. Ent. Zeit., v, 154.

1877. *Epibates* Osten Sacken, Bul. U. S. Geol. Surv., iii, 268.

A large number of species of this genus have been described from our fauna, and it may be inadvisable to add to the list, especially as most of the species described are represented by only one sex. Some of the species seem to be sexually dimorphic, which is more reason why care should be taken in describing new forms. The two species herein described are apparently represented by both sexes.

***Eclimus laniger*** new species.

Apparently near *funestus* O. S., but no mention is made in the description of that species of the conspicuous golden yellow, appressed, wooly hair of the mesonotum and abdomen which is present in this species. It is also not likely that the present species is conspecific with the eastern *funestus*.

♂. Black; squamæ, stalk of halteres, pale. Legs light to dark brown. Wings brownish, becoming more intense along costa beyond anterior cubital vein, and diluting to hyaline basally especially in anal cell. There is a distinct infuscation in submarginal above anterior cubital vein where the wing is slightly wrinkled. Opaque, velvety black. Frons, face slightly, cheeks, occiput below, pleura, white to gray. Pile black on ocellar tubercle, upper occiput, face, first and second antennal joints, mesonotum, pleura above, scutellum, and fourth and following abdominals. White on cheeks and occiput below, pleura below, and venter of first to fifth segments. First to third abdominal segments yellowish laterally. Mesonotum, scutellum, abdomen (especially apices of first to fifth segments) sparsely golden yellow lanuginose. All bristles black, also tuft of metapleural pile. Head not much broader than high, hemispherical in profile. Eyes contiguous for nearly full distance to antennæ. Third antennal joint longer than first and second together. Mesonotum distinctly mucronate, but costa smooth. Length, 7-9 mm.

♀. Similar, but all pile except on frons white. Infuscation of wings more even except that the stigma, marginal, and first basal cells are more intense, and there is some clouding on the cross veins; second basal, anal, and axillary cells hyaline.

*Type*.—♂; Mesa Grande, Sonoma County, California, June, 1908, (J. P. Baumberger), [A. N. S. P. No. 6205]. *Paratypes*.—1 ♂, 1 ♀; topotypical.

***Eclimus yosemite* new species.**

The two specimens representing this species are so different in coloration that, were they not taken at the same place and time, one would be certain to consider them distinct species. Of course, it is possible that they are distinct, but it would be inadvisable to consider them as such. The male differs from the description of *luctifer* O. S., in that the mesonotum is not mucronate. The female differs from *magnus* O. S., in that the pile of the mesonotum is white.

♂. Black; squamæ and stalk of halteres, pale. Wings nearly uniformly intense brown, becoming most intense along costa, with slight dilutions basally towards axillary cell, Opaque, velvety black, but oral and scutellar margins shining. All bristles black. Pile black on ocellar tubercle, first and second antennal joints, frons, face, occiput medianly as a continuation of the notopleural stripe, lateral margin of abdomen, all of sixth and following segments, ventral segments, and legs. White on cheeks, occiput below, pleura, metapleural tuft, and squamæ. Yellowish on occiput above, mesonotum, scutellum, dorsum of segments one to five. Some pile on mesonotum laterally; apices of abdominal segments one to five, wooly and somewhat appressed. Head much broader than high, subhemispherical in profile. Eyes separated for about width of first antennal joint. Third antennal longer than first. Mesonotum not mucronate. Costa smooth. Length, 8 mm.

♀. Similar but larger (12 mm.) and more robust. Wings dilute brown, becoming intense at costa and on anterior cubital vein. Bristles pale. Pile on occiput above, mesonotum, scutellum, squamæ, metapleural tuft, and dorsum of segments 1-4, white, and generally long, becoming appressed and curly on lateral mesonotal margins and apical margins of abdominal segments. All other pile on head, pleura, venter, and fifth and following segments, black and abundant. Length, 12 mm.

*Type*.—♂; Yosemite Valley, California, May 22, 1908, (E. T. Cresson, Jr.). [A. N. S. P. No. 6206.] *Paratype*.—♀; topotypical.

**GERON Meigen.**

Were it possible to have all material of this genus in perfect, unabraded condition, there might be some chance of finding more characters of differentiation than one is able to do with the specimens usually met with in collections. The study and examination of the small amount of material before me, however, gave some results worthy of note, and which will at least separate several species

without much trouble. The types of Loew, Coquillett, and others, should be studied in conjunction with the few notes given below in order to fix more definitely the status of some of the species of those authors. To eliminate the chances of misidentification, I give new names to the forms herein described, knowing full well that there is a possibility of synonymy regarding some of them.

The form of the genitalia of the male and of the seventh ventral segment of the female, offers the most satisfactory characters for separating several species, or, possibly, groups of species. The venation, with one exception, offers no usable characters, but the color of the vesture may prove to be more valuable if perfectly preserved specimens are available for study. In other respects, in structure and color, there seems to be very little of value. The genitalia of the male offers two distinct types, which may, on more detailed study, show still other characters of value. The organs mentioned are generally well exposed and easily seen. One type has the "claspers" well developed, paired, upper and lower, finger-like. The other type has no distinctly developed "claspers," but the parts corresponding to these are developed into a polished, chitinous, half disk-like organ, with a rosette of two to four thorn-like processes or filaments. As mentioned above, there are probably, within these two types, other characters which may prove valuable. In the present study this detailed examination is not undertaken.

***Geron digitaria* new species.**

♂. Black; oral margin, halteres including stalk, squamæ, bases of wings, pale yellowish. Tibiæ brownish. Opaque. Frons, face, occiput below, lateral margins of mesonotum, pleura, venter, femora, gray to white pruinose. All pile silvery white, becoming slightly dusky on dorsum where it is sparse. Dorsum also sparsely golden lanuginous, becoming silvery below. First antennal joint black, pilose. Third longer than first two together, slender, conical. Ultimate section of fourth vein longer than preceding. Claspers of hypopygium finger-like. Length, 5 mm.

*Type*.—♂; Highrolls, New Mexico, June 11, 1902, (Viereck), [A. N. S. P. No. 6207.]

A series of eight males from New Jersey, Pennsylvania, Maryland, Delaware, and Virginia, varying in size from 3–5 mm. are apparently conspecific. The pile on the dorsum, when present, is generally golden brown. A series of seven females from Pennsylvania and Maryland may be associated with the above males, and are similar,

with the frons brown and golden lanuginose medianly; orbits cinereous. The seventh ventral with sublateral, rounded lobes, which, at most, slightly overlap.

The above specimens may be *subaurata* Lw., or *vitripennis* Lw., while *albipennis* Lw., may be represented by a series of 6♂, 12♀ from Cloudcroft, (May), Alamogordo, (April), Highrolls, (June), East Las Vegas, (June), all of New Mexico, and Ysleta, Texas, (April), this specimen differing from the above as follows: Dorsal pile white; the lanuginose vesture not so yellow, that of the frons in ♀ being entirely silvery.

The two forms seem to be more or less intergradant but may prove to be distinct species upon more detailed study.

***Geron digitaria* var. *robusta* new variety.**

Ranging larger than the typical form, and very similar except that the pile of first antennal joint is white; of the dorsal surfaces of the body, golden yellow as is also the lanuginose vesture above. The lobes of the seventh ventral are somewhat pointed and are more distinctly developed, apparently as separated developments of the ventral segment. The male of this form may be difficult to separate from those of *digitaria*, but the female certainly represents a distinct variety. Length, 5-7 mm.

*Type*.—♀; Hancock, Maryland, August 15, (F. R. Cole), [A. N. S. P. No. 6208]. *Paratype*.—1♀; topotypical.

***Geron nivea* new species.**

Similar to *digitaria* but all pile snow white; the lanuginose vesture white and yellow mixed on the dorsum; middle tibiae pale. Genitalia of male broad when seen from above, with a lateral, subapical, conical tubercle and a lateral subbasal spine-like filament. The females have no golden tomen on the frons, and the lobes of the seventh ventral overlap, appearing as a ventral segment.

*Type*.—♂; East Highlands, California, September 15, 1914, (F. R. Cole), [A. N. S. P. No. 6209]. *Paratypes*.—1♂, 1♀; topotypical. A male from Alamogordo, New Mexico, April, (Rehn & Viereck), seems to be conspecific.

A series of 6♂, 3♀, Manayunk, Pennsylvania, Jamesburg, New Jersey, and Linnieville, Maryland, July, (R. C. Shannon), are probably a variety of this species. The dorsal pile is yellow and the lanuginose vesture yellow.

***Phthiria psi* new species.**

This form runs to *divisa* in Coquillett's table (*Trans. Amer. Ent. Soc.*, xxi, 102) but differs considerably from that species.

♀. Yellow, with black as follows: Spot on ocelli, frons medianly, tip of third antennal joint, proboscis, three broad, more or less coalescing mesonotal stripes, the lateral ones abbreviated anteriorly and somewhat interrupted at suture, the median one abbreviated posteriorly also, spot on mesopleura, sternopleura and on hypopleura, and apices of tarsi. Wings hyaline. Pile sparse, short and pale. Head much broader than long. Vertex one-third width of head. Proboscis extending twice length of head; palpi a little beyond epistoma. Costal length between second and fork of third three times that between first and second; anterior cross vein far beyond middle of discal cell. Length, 3.5 mm.

*Type*.—Redlands, California, 1912, [F. R. Cole Coll.].

In some specimens the frons may prove to be dark medianly and the abdomen shows dark bases to segments.

***Lordotus divisus* new species.**

Distinguished from all known species by the entirely black pile on the thorax and abdomen.

♂. Black; knob of halteres and squamæ whitish yellow. Wings clear; veins yellow; antecostal cell black. All pile black, becoming brownish on scutellum. Cilia of squamæ alaris white, of squamæ thoracalis brown. First antennal joint nearly as long as third; second not longer than broad. Proboscis extending in length equal to that of head and thorax together; palpi as far as second antennal joint. Length, 6–8 mm.

*Type*.—♂; Alamogordo, New Mexico, April 30, 1902, (Viereck), [A. N. S. P. No. 6215].

***Heterostylum vierecki* new species.**

Differing from *robustum* O. S., in having the scutellum black, and the pile of the second abdominal segment wholly black. Differing from *sackeni* Will., in having the facial pile white.

♂. Black; face, halteres, fourth and fifth abdominal segments excepting a medial stripe, fore and middle tibiae, pale. Wings entirely brown, becoming diluted along inferior margin. Pile black on ocellar tubercle, frons, first antennal joint, scutellum in part, all on second, sixth and genital segments, third except basal row, medially on segments 4–5, and most of venter. White on face, occiput, pleura, first abdominal segment. Yellow on mesonotum, scutellum in part, and remainder of abdomen, but on latter mixed with white. No bristles except the red ones at roots of wings. Opaque. Frons, face, first

and second antennal joints, occiput and pleura, gray to white pruinose. Mesonotum rather brownish. Scutellum slightly shining. Femora and tibiae yellow tomentose. First antennal joint one-half as long as third; second globose; third gradually tapering to a minutely styled apex. Proboscis extending, in length equal to head and thorax together. Palpi short. Length, 7-9 mm.

♀. Similar, but pile on mesonotum mostly black.

*Type*.—♂; Alamogordo, New Mexico, April 22, 1902, (Viereck), [A. N. S. P. No. 6216]. *Paratypes*.—1♂, 1♀; topotypical. 4♀; El Paso, Texas, April 5-26, 1902.

The series shows little variation. The line of fine white hairs of the third abdominal segment is sometimes wanting, and the black pile of the fourth segment sometimes extends to basal half; the pale pile limited to the mixture on the lateral margin and on the pale ground-part of the fourth and fifth segments.

***Bombylius facialis* new species.**

♂. Black; face brown; halteres whitish; apices of middle and hind femora, all tibiae, yellow to tawny. Wings infuscated basally and along costa, becoming hyaline apically and inferiorly. Face shining; mesonotum and scutellum subopaque. Frons yellowish pilose, and yellow tomentose; tubercle, face and antennae, black pilose; occiput, mesonotum, and scutellum, pale yellowish pilose; abdomen also pale except narrow apices of segments 2, 3, 4, which are black. Cheeks, pleura, pectus and venter, white pilose. Femora white tomentose; fore and middle ones with white hairs, and hind one with black bristles, below. Apices of second to fifth abdominal segments pale yellow tomentose which is slightly more dense medially, suggesting a medial dorsal line. Third antennal joint longer than first two together, cylindrical, narrower than second, with short terminal style. Proboscis as long as head, thorax, and abdomen together. First submarginal cell not broader at apex than at base of second submarginal. Length, 7-8 mm.

*Type*.—♂; Rim of Grand Canyon, Arizona, 7000 feet, alt., May 23, 1918, (F. M. Jones), [A. N. S. P. No. 6213].

A female from Oracle, Arizona, April 28, (F. M. Jones), is apparently conspecific with the above male. It has the dorsal pile more yellowish; tomen of abdomen covering the entire segments; pile at vertex black; anterior part of frons with pale pile and pale tomen; a little pale pile at epistoma; third antennal joint broader and suddenly pointed apically.

I cannot associate these specimens with any description, but realize that in this little understood genus they may have been described previously. However, I hesitate to let these well-preserved specimens remain in the collection without a name or with a temporary determination.

#### MYDAIDÆ.

##### *Ecthypus limbatus* Will.

1886. Williston, Trans. Am. Ent. Soc., XIII, 292.

Before me is a male from Waterman Canyon, Amador County, California, May, (J. C. Martin), [Cal. Acad. Sci.], which is apparently this species. The species is based on a female from Arizona. The male is herewith briefly described.

Rufous; occiput, frons, proboscis, apex of third antennal joint, three mesonotal stripes, notopleural stripe, pectus, bases of first and second abdominal segments, lateral margins of remaining segments, bases of ventral segments, and apical appendages of hypopygium, black. Apical margins of dorsal and ventral segments conspicuously yellow. Wings except apices yellowish tinged. Proboscis projecting slightly beyond second antennal joint; third antennal joint slender, five or six times as long as first two together; club consists of about three-fourths of third joint, robust, of about equal width throughout, except at apical fourth, which tapers. Hind femora thickened at apical three-fourths and spinose beneath; tibiæ straight. First posterior cell open. Length, 24 mm.

##### *Leptomysdas pantherinus* Gerst.

1868. Gerstaecker, Stet. Ent. Zeit., XIX, 85.

The males here are black except the knees, tibiæ, tarsi, and posterior margins of the abdominal segments especially the apical ones.

Before me are 4♂, 4♀, from the following localities in California: Colma, July to August, (J. A. Kusche), [Cal. Acad. Sci.]. San Francisco, March, (J. A. Kusche), [Acad. Cal. Sci.]. Mesa Grande, Sonoma County, June, (J. P. Baumberger), [A. N. S. P.].

##### *Leptomysdas sponsor* O. S.?

1886. Osten Sacken, Biol. Cent. Amer., Dipt., I, 68.

A male from Coronado, May, (F. E. Blaisdell), [Cal. Acad. Sci.], which seems to be this species has the following characters:

Head and thorax entirely black with white polished pilose markings. First abdominal segment and following ones, laterally, black;

lateral apical angles of two to six white; remainder of abdomen rufous. Fore and middle femora dark basally; apices of their tibiae, and tarsi yellow. Hind legs except coxae rufous. Wings brownish with darker borders to the veins. Proboscis as long as the black antennae. Halteres black.

***Leptomydas brachyrhynchus* O. S.?**

1886. Osten Sacken, Biol. Cent. Am., Dipt., 1, 69.

There are before me from the following California localities: 3♂, San Diego, and Mokelumne Hill, Calaveras Co., (F. E. Blaisdell), [Cal. Acad. Sci.]; 1♀, Barstow, San Bernardino Co., June, (J. R. Haskin), [Cal. Acad. Sci.]. Although these were collected from widely separated localities, they seem to be conspecific. The only difference in the Mokelumne Hill specimen is the narrow, dark, bases of the abdominal segments and the slight paling in the color of the apex of the antennal club.

A brief description of the male is given below. The species is based on a female from Mexico.

♂. Wax yellow; head except middle of face, apices of third antennal joint and entire club, mesonotum except humeri and lateral margins, scutellum, more or less of pectus, metanotum, first abdominal segment, stigmatic spot on second, spot on lateral margins of all segments, and halteres, black. All pilosity yellow. Two median and lateral mesonotal stripes and sometimes apex of club, pale. Wings yellow. Bases of abdominal segments sometimes narrowly black. Third antennal joint three times as long as first two together, equalling the club; the latter tapering to near apex, then abruptly attenuating to a rather blunt apex. Proboscis short. Hind femora slightly thickened on apical half, with few flexor bristles; tibiae without spurs. First posterior cell closed. Length, 17 mm.

**SYRPHIDÆ.**

***Omegasyrphus baliopterus* Loew.**

1872. *Microdon baliopterus* Loew, Berl. Ent. Zeit., xvi, 86. (Cent., x, 56.)

Originally described from Texas. I can report the following: One male from Mexico with the first posterior cell completely divided by the extension of the stump from the third vein. One female from Round Mountain, Texas. One female, Mill Valley, California, June, (E. P. VanDuzee), [Cal. Ac. Sci.]. The last is a dark specimen showing the antennae black, or, in certain angles the first joint brownish; femora black with tibiae and tarsi brownish.



Otherwise similar to, and apparently conspecific with, the two first noted specimens.

**Mixogaster breviventris** Kahl.

1897. Kahl, Kans. Univ. Quart., vi, 137.

Originally described from Kansas. Before me are two specimens from Yaphank, Long Island, New York, September, (W. T. Davis).

**Callicera johnsoni** Hunter.

1896. Hunter, Can. Ent., xxviii, 87.

One male from Round Mountain, Texas, differs somewhat from the original description. It wants the opaque marks on the face, cheeks, and abdomen, except that there are faint indications of narrow, semi-opaque bands on second and third segments.

**Callicera montensis** Snow.

1892. Snow, Kans. Univ. Quart., i, 34 (pl. vii, f. 4).

One specimen, Grand Canyon, Arizona, 7000 feet alt., May, (F. M. Jones). This agrees with the original description but the pile of the pleura, pectus, and venter of the abdomen is black. Snow says that the pile of the thorax and abdomen is "everywhere" golden red. The pile of the eyes in this specimen is blackish brown, not golden. The third antennal joint is at least four times as long as the first and second together. No pale articulations on the tarsi.

Can this be distinct from *montensis*? The species was originally described from Colorado, 9000 feet alt., and subsequently reported from New Mexico, at 9500 feet alt.

**Merodon equestris** var. *validus* Verr.

1822. *Merodon validus* Meigen, Syst. Besch., iii, 365.

1901. *Merodon equestris* Fab. var. *validus* Verrall, Brit. Flies, viii, 559.

One female, San Francisco, California, April, (C. L. Fox), [Cal. Ac. Sci.].

CONOPIDÆ.

**Dalmannia blaisdelli** new species.

Differs from *picta* Will. and *nigriceps* Lw. in having the pilosity black, although on the second and third abdominal segments of the male it is somewhat paler.

♂. Abdominal segments 2, 3, 4, narrowly yellow at apices, which color extends basally at the middle as a wedge but not attaining the bases of the segments; fifth segment with a medial yellow spot. All

femora black except the broad apices. All pile black except on second and third abdominal segments. Length, 6-7 mm.

♀. Similar but the yellow on segments 3, 4, 5, with sublateral, rectangular prolongations basally and the medial wedge attains base of fifth; sixth segment yellow with two black apical converging stripes. Femora yellow except fore one above; and hind one with subapical black ring. All pile black.

*Type*.—♂; Colorado [A. N. S. P. No. 6211]. *Paratype*.—1 ♀, Mokelumne Hill, Calaveras Co., California, August, (F. E. Blaisdell), [Cal. Acad. Sci.].

#### ORTALIDÆ.

##### *Rivellia cognata* new species.

Same as *flavimana* Lw. but the legs are entirely yellow excepting that the hind tibiæ and apices of tarsi are brownish, but never black. The wing markings are similar.

*Type*.—♂; Swarthmore, Pennsylvania, June 11, 1905, (E. T. Cresson, Jr.), [A. N. S. P. No. 6212]. *Paratypes*.—2 ♂, 1 ♀; topotypical.

A series of seventeen specimens from the following localities: Pennsylvania: Manayunk, Philadelphia, Swarthmore. New York: Ithaca. New Jersey: Medford. Georgia. Florida: St. Petersburg. Wisconsin: Beaver Dam. It seems to be more common than *flavimana* in collections. There is much to suggest *Herina metallica* v. d. Wulp, but I cannot find any reference in the description of or in the figure of that species that the costal cell is entirely infuscated. The figure shows the infuscation only at the extreme base, while with the present form this color extends to the first band as it does in *flavimana*. There should not be any confusion between the present form and *quadrifasciata*. In that species the first basal cell is entirely infuscated and the abdomen often rufous, and on the whole is a much more robust species.

#### SEIOPTERA Kirby and Spence.

1817. Kirby and Spence, Intro. Ent., II, 305.

1830. *Myodina* Desvoidy, Essai Myod., 727.

1867. *Seoptera* Loew, Berl. Ent. Zeit., XI, 295.

This genus was proposed in a very meagre way, but as a species is included in the original citation, the name is valid. It is based on *Musca vibrans* Linn. (1761). The limit of the genus has been very much restricted as only one or two species are known to belong to it.

In the study of some North American material in conjunction with typical *vibrans* from Europe, I have made some notes on the genus and the species included, and have found a new form which seems to belong here. The form found within our fauna has been listed in the catalogues and placed in collections as *colon* Lw., and sometimes as *vibrans* Linn. For some time I have been endeavoring to separate these by means of the descriptions, notes given by Loew, and examination of material, but with no degree of satisfaction. A critical study of a specimen of *vibrans* from Europe has given the same result, and so it is evident to me that *colon* and *vibrans* are synonymous. The examination of the types of these two species may give contradictory results.

***Seioptera vibrans* Linn.**

1761. *Musca vibrans* Linnaeus, Faun Suec., 1867.

1867. *Seioptera colon* Loew, Berl. Ent. Zeit., xi, 296, (Cent., ii, 6).

In this species we have the frons one-third to one-fourth width of head, opaque, red orange, not with conspicuous silvery orbits; median orange portion black setulose. Face slightly lighter, more yellowish, in profile nearly straight on account of the prominent, obtuse keel; orbits silvery. Cheeks concolorous. Occiput, thorax and abdomen, shining black. Legs black but tarsi brown, especially basally. No supraalar bristles. Mesopleura with pale micro-pubescent; sternopleura with 1-2 bristles well separated. Ovipositor with basal segment narrow, much narrower than long. Wings hyaline with stigma and spot at apical margin infuscated. First posterior cell narrowed so that its apex is no broader than its base. Anal cell with slight point at apex.

The specimens from our fauna, with one or two exceptions, seem to have only one sternopleural bristle. These bristles are so slender and hair-like that they are probably variable. Seventeen male and six females have been examined from Canada, Rhode Island, New York, Pennsylvania, Illinois, and Montana.

***Seioptera albipes* new species.**

Here we have a species offering a different facial profile from that of *vibrans*, being distinctly concaved with a weak carina. The frons is broader than in that species, with shining orbits which are only very narrowly silvery. There is a distinct supraalar bristle and the mesopleura are black, setulose or pubescent; sternopleura with two hair-like bristles close together. The fore tibiae and tarsi,

and middle and hind tarsi are white; the latter not at all darkened apically. The fore tibiae may be darkened at bases and the middle tibiae may be light brown. The basal segment of ovipositor is very large, about one-half as long as the abdomen and as broad as long. The first posterior cell is broader at apex than at base, almost twice as broad; anal cell truncate, not acute. In other respects similar to *vibrans*.

*Type*.—♀; Swarthmore, Delaware County, Pennsylvania, May 25, 1912, (E. T. Cresson, Jr.), [A. N. S. P. No. 6210]. A series of 1♂, 3♀, from Ithaca, New York, May to June, [Cornell] are conspecific.

That this species may not be congeneric with *vibrans* is possible, but I am unable to place it in any other genus. The fact that *Sieoptera* is not a typical Ulidiinae, especially in the construction of the anal cell, allows one to enlarge somewhat on its limits. The present species will no doubt be found in many collections under *colon* or *vibrans*.

#### PSILIDÆ.

##### *Psila angustata* new species.

Similar to *lateralis* Lw., but larger and the third antennal joint is much longer. In *lateralis* the size is 3.5–3.9 mm., and the third antennal joint is scarcely longer than the second. Tawny to yellow; third antennal joint apically, occiput spot, face medianly, faint spot behind vertical bristles, pleural stripe under humeri to base of halteres, and entire abdomen, black. Lower part of pleura, coxæ, and legs, pale yellow. Wings hyaline, yellowish to brownish along costa and veins. Arista white pubescent. Third antennal joint slender, three times as long as second. Length, 4.7–5.9 mm.

*Type*.—♂; Ithaca, New York, August 23, 1904, [Cornell University]. *Paratypes*.—3♂, 5♀; topotypical.

#### PIOPHILIDÆ.

##### *Mycetaulus hornigi* new species.

Agreeing with the generic description of *Mycetaulus*, but superficially simulating *Piophila nigriceps* Meig. The two dorsocentral bristles each with a stout setula before it, but behind the suture, and are readily distinguished from the short abundant pile. Fore femora with 3–4 flexor bristles at apical end of the posterior flexor series of hairs.

♂. Black, polished. Occiput subopaque but not polished. Propleura with silvery dot. Second antennal joint, base of third, base

of fore femora, middle and hind legs including coxæ entirely, and veins, yellow. Fore coxæ, squamæ, and halteres white. Wings entirely clear. Frons one-third width of head, but slightly narrowed at antennæ. Cheeks broad as third antennal joint. Scutellum flat. Posterior cross vein slightly longer than ultimate section of fifth; anal vein slightly curved, not attaining margin.

*Type*.—♂; Philadelphia, Pennsylvania, June 3, (H. Hornig), [A. N. S. P. No. 6217]. *Paratype*.—♀; topotypical.

**MOLLUSCA OF GLACIER NATIONAL PARK, MONTANA.**

BY S. STILLMAN BERRY.

## INTRODUCTION.

During the month of August, 1916, in the course of a brief vacation in the Glacier National Park, Montana, the writer incidentally made a small collection of mollusks, which, though doubtless not in any way complete for even those portions of the region visited, is none the less of considerable interest, particularly from the standpoint of the zoogeographer. The facts, that within the boundaries of this Park the three principal continental watersheds find their point of junction, and that collections were made on all three sides of the continental pinnacle thus formed, give a peculiar interest to the records. To the great, rough, triangular rock called Triple Divide Peak, belongs the honor of being, at least so far as drainage goes, the top of the North American Continent. One of its three faces drains into Norris and Red Eagle Creeks, and thence via the St. Mary's and Saskatchewan Rivers into Hudson's Bay; one drains into Cut Bank Creek and thence via the Marias River and the Missouri-Mississippi into the Gulf of Mexico; the third drains via Nyack Creek and the Flathead and Columbia Rivers into the Pacific.

This will suffice to indicate why the student of geographical distribution must find a peculiar interest in the elucidation of the fauna of the region, though unfortunately the present collections are not sufficiently complete that any very general conclusions may be safely drawn, even for the single phylum Mollusca. They were carried out at odd moments along the trail or while stopping to rest, and nowhere was it possible to make them reasonably exhaustive.

The writer was accompanied on the entire expedition by Mr. Elwyn H. Dole, of Winnecook, Montana, and during the latter part of the tramp by Dr. A. H. Warthin, of the University of Michigan, and his son, Master Aldred Warthin. His thanks are due to each of these gentlemen for help in the work of collecting, as well as to Mr. E. G. Vanatta, of The Academy of Natural Sciences of Philadelphia, for his critical comparison of certain specimens with others in the collections of the Academy.

The total number of species taken was not large—some eleven of land snails and a single freshwater bivalve—but several con-

stitute new records for the state, and one, the interesting *Polita chersinella* (Dall), has previously been known only from the Californian Sierras. One subspecies, *Oreohelix cooperi apiarium* is here described as new. *Euconulus fulvus (alaskensis ?)* proved by all odds the most abundant and widely distributed species in the Park, being taken at 14 of the 18 stations. Other relatively abundant forms are *Vertigo modesta parietalis* (a good second to *Euconulus*), *Oreohelix cooperi apiarium*, and *Thysanophora ingersolli* (though for both of these last two species the figures to be quoted include dead shells). We did not discover how to find the *Oreohelix* or the *Polita binneyana* until toward the end of the trip, else the figures for each of these might have been larger.

It is evident that the fauna as a whole exhibits a markedly boreal or Hudsonian aspect, in which the occurrence of such species as *Oreohelix cooperi apiarium*, *Polita chersinella*, and *Punctum californicum* seems more or less anomalous. Quite unexpectedly the list is an altogether different one from that collected by the late Mr. L. E. Daniels in the Bitter Root Mountains and reported upon by Mr. Vanatta in these PROCEEDINGS for 1914 (Vanatta :14). Though his list is a much more extensive one, some seven species, or just one more than half of those here recorded, fail to appear therein.

A first duplicate series of the specimens taken has been deposited in the collections of the Academy.

#### HISTORICAL.

In my search of the literature I have been unable to discover any previous record of Mollusca taken within the actual confines of the Glacier National Park with the single exception of a note by F. C. Baker (:14, p. 106), wherein he mentions finding some dead shells of *Oreohelix cooperi*, "at Glacier National Park, Montana, in a ravine about a mile west of the hotel."

Some collecting was done by Dr. G. M. Dawson in 1874, and Mr. J. B. Tyrrell in 1883, just north of the present Park near Waterton Lake on the Canadian side of the boundary, and *Oreohelix cooperi limitaris* (*Helix limitaris* Dawson) was described from the material taken, but most of the records seem never to have been published.

#### LIST OF STATIONS WITH DATA.

The recorded stations from which mollusks were taken on this expedition are eighteen in number, being in consecutive order as

follows. Two of the stations (I and XVIII) are really extralimital to the Park:

*Station I.* Mt. Henry Trail, 3 miles northwest of Glacier Park Station, just outside the eastern boundary of the Park; alt. 5300 ft.; August 20, 1916; under sticks and bits of bark in moist places along the trail.

*Station II.* Mt. Morgan Trail, Dry Fork Canyon; alt. 5200-6000 ft.; August 21, 1916; under sticks, stones, etc., at various intervals along trail; most of the Vertigos found under one small log.

*Station III.* Cut Bank Creek; alt. 5800 ft.; August 21, 1916; under sticks not far from creek.

*Station IV.* North Slope Triple Divide Pass; alt. 6600 ft.; August 22, 1916.

*Station V.* Near Going-to-the-Sun Chalets, Gunsight Trail; alt. 4600 ft.; August 25, 1916; among loose rocks on slope near trail. (Plate IX, fig. 1.)

*Station VI.* Piegan Pass Trail, on west slope of Going-to-the-Sun Mountain; alt. 6000 ft.; August 26, 1916; under sticks except *Oreohelix*, which was crawling on surface.

*Station VII.* Lower end of Grinnell Lake; alt. 5000 ft.; August 26, 1916; under sticks.

*Station VIII.* Southeast shore of Lake Josephine; alt. 5000 ft.; August 26, 1916; under sticks.

*Station IX.* Along road northwest of Lake McDermott; alt. 5000 ft.; August 27, 1916; under sticks and bark. (Plate IX, fig. 2.)

*Station X.* Ptarmigan Falls; alt. 5600 ft.; E. H. Dole, August 27, 1916; under sticks, bark, etc.

*Station XI.* Pool near lower end of Iceberg Lake; alt. 6000 ft.; August 27, 1916. (Plate IX, figs. 2-3.)

*Station XII.* Upper end of Swiftcurrent Canyon; alt. 5200 ft.; August 28, 1916; under sticks and small logs on floor of canyon along trail. This station proved one of the most prolific of any at which collecting was done. (Plate IX, fig. 2.)

*Station XIII.* Granite Park Trail, just below Granite Park Chalets; alt. 6000 ft.; August 29, 1916; under sticks and small logs along trail.

*Station XIV.* Granite Park Trail, near Mineral Creek, at bottom of canyon below Granite Park; alt. 3859 ft.; August 29, 1916; mainly under sticks and pieces of bark around fallen logs along the trail. The best locality for small land snails we found in the Park. The forest in this canyon is magnificent and very dense.



*Station XV.* Granite Park Trail, bottom of McDonald Creek Canyon under Haystack Butte; alt. 3650 ft.; August 29, 1916; the *Oreohelices* found aestivating among a growth composed principally of *Rubacer*, *Ribes*, *Urtica*, *Fatsia*, and cow parsnip, the *Polita binneyana* in association.

*Station XVI.* Granite Park Trail, bottom of McDonald Creek Canyon opposite Glacier Wall; alt. 3550 ft.; August 29, 1916; same characteristic plant association as for preceding station.

*Station XVII.* Granite Park Trail, bottom of McDonald Creek Canyon, under Mt. Cannon; alt. 3450 ft.; August 29, 1916; same characteristic plant association as for preceding two stations.

*Station XVIII.* Belton, Montana, just outside southwestern boundary of Park; alt. 3300 ft.; E. H. Dole, August 30, 1916.

Reference to a map will show that Stations I-III are in the Atlantic drainage basin, IV-XII in the Arctic drainage basin, and XIII-XVIII in the Pacific drainage basin. The terrestrial species as a rule were found to occur in all three watersheds, but *Polita binneyana* and *Striatura milium pugetensis* were noted only on the Pacific side.

#### CENSUS OF SPECIES TAKEN.

The accompanying table gives a good idea of the relative abundance of the various species collected, both absolutely and with reference to the station and drainage data.

#### NOTES ON THE SPECIES.

*Oreohelix cooperi apiarium* new subspecies. Plate X.

The shell is large for this group of *Oreohelices*, strongly elevated, with an obtuse apex. The spiral sculpture is obsolete below, but strong on the upper half of the whorls where it consists of numerous fine striations, quite visible to the naked eye, which are interrupted by the coarse and very irregular lines of growth. The periphery is obtusely angular in front, becoming rounded or with just the faintest suggestion of angulation on the remainder of the last whorl. The umbilicus is narrow and deep, contained in the diameter about six times, its circular outline partially interfered with by the slightly reflexed inner lip.

The color is extremely variable, the ground color of the shell ranging from a very light brownish cream, almost white, through shades of yellowish brown to dark chestnut, and tones of gray to a livid brownish slate. The adult shell usually shows two narrow

TABLE SHOWING RELATIVE ABUNDANCE OF SPECIES TAKEN.

Drainage Stations	Atlantic			Arctic								Pacific					Total No. Specimens	No. Stations Collected	No. Water-sheds			
				IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI				XVII	XVIII	
	I	II	III																			
<i>Oreohelix cooperi apicarium</i> Barry.....					11 <sup>1</sup>	4							9	1	25	45	37	15		112	5	2
<i>Thysanophora ingersolli</i> (Bland).....		19			48	3					2 <sup>1</sup>		2		13		2			109	8	3
<i>Pyramidula cronchites</i> (Newcomb).....		7	2										30		7	1				24	4	3
<i>Punctum californicum</i> Pilsbry.....		4	1	3	1		3		4	5					20	1				58	9	3
<i>Zonitoides arborea</i> (Say).....					2 <sup>1</sup>				1						40	2			3	28	6	3
<i>Euconulus fulvus alaskensis</i> Pilsbry.....		8	13	1	22	4	1	5	27	3		24	2	2	40	2	1		5	157	14	3
<i>Polita binneyana</i> (Morse).....															2					11	3	1
<i>Polita chersinella</i> (Dall).....						3			1			3			1		1			10	5	3
<i>Striatula multum pugelensis</i> (Dall).....															5	1	1			7	3	1
<i>Vitrina alaskana</i> Dall.....		1	2				1		1				70	1	1	1				9	8	3
<i>Vertigo modesta parietalis</i> (Ancey).....		8	23		3	2	3		7						39					155	8	1
<i>Pandium abditum</i> Haldeman.....												81								81		

Total 761

<sup>1</sup> Dead shells only.

darker bands, one on the shoulder, the other just below the periphery, with sometimes a broader light band between, and several weaker and narrower bands below extending upon the base of the shell. Entirely bandless specimens seem to occur but rarely.

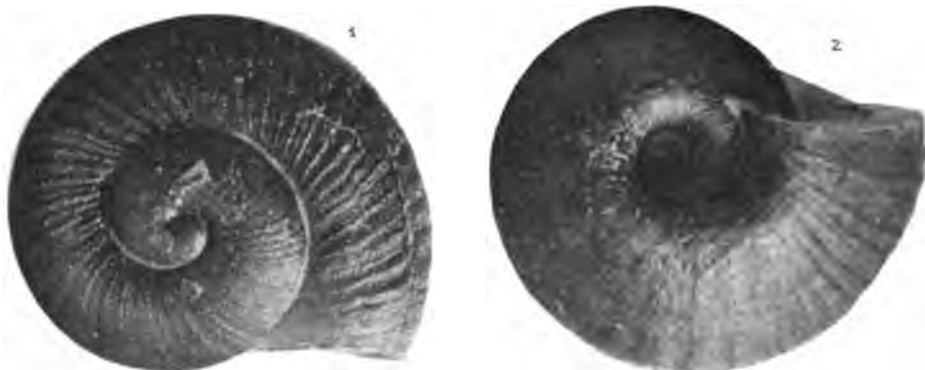


Fig. 1. *Oreohelix cooperi apiarium* new subspecies. Apical and basal views of shells of unborn young, taken from specimen shown in Pl. X, Fig. 2-2b (type).  $\times 13$ .

The embryonic shell is lenticular in outline and strongly carinate as usual in the genus. It is sculptured with numerous very fine, crowded, wavy, spiral striae, crossed on the neanic portion by coarser, but still narrow, rather irregularly spaced, wrinkle-like, incremental ridges, some of them eventually becoming almost rib-like above, but practically obsolete below the periphery, where, however, the fine spiral striation is in these young specimens beautifully developed.

	Largest from Station XVI (Type)	Smallest Adult Station XVI	Largest, Station XV
Maximum diameter.....	22.0 mm.	15.6 mm.	23.2 mm.
Minimum diameter.....	21.3 mm.	15.1 mm.	20.3 mm.
Altitude.....	19.6 mm.	15.4 mm.	18.0 mm.
Diameter of umbilicus.....	3.5 mm.	2.5 mm.	3.7 mm.
Number of whorls.....	6½	6	6
Illustration, Plate X.....	Figs. 2-2b	Figs. 7-7b	

*Type*.—Cat. No. 4130 of the writer's collection; paratypes in The Academy of Natural Sciences of Philadelphia, the University of Colorado Museum, and the California Academy of Sciences.

*Type Locality*.—Station XVI, altitude 3550 ft., McDonald Creek Canyon, opposite Glacier Wall, Granite Park Trail, Glacier National Park, Montana; 37 specimens.

*Remarks.*—Despite its great size, *O. c. apiarium* is nearer, I think, to *O. c. limitaris* (Dawson) than to any of the other described races of the *cooperi* complex. The latter differs in its very much smaller size, less elevation, rather greater carination of the front part of the last whorl, and very much weaker spiral striation on the upper portion of the whorls. Relative to the size of the shell the lines of growth are coarser in *limitaris*, and the adult shell has from  $\frac{1}{2}$  to  $\frac{3}{4}$  of a whorl less.

*Limitaris* has long been greatly misunderstood, and for a time I thought the Glacier Park race might prove to be identical with it, but the recent receipt of good comparative material from the type locality of *limitaris*, through the kindness of Mr. Frits Johansen, of the Geological Survey of Canada, has led me to the conclusion that the two are measurably distinct, though *limitaris* comes from near Waterton Lake, just over the border from Glacier Park, Montana.

If these conclusions are correct, both *apiarium* and *limitaris* will stand as reasonably well differentiated subspecies of *O. cooperi* (Binney). The McDonald Creek Canyon shells are among the most elevated and largest *cooperi* I have seen, being surpassed in bulk only by Pilsbry's *O. c. maxima* from the Yellowstone National Park. *Maxima* further differs in its more depressed contour and much more capacious umbilicus. For the loan of a specimen of *maxima* permitting my direct comparison of the two I am indebted to Dr. Pilsbry.

Another shell which is probably quite close is that represented by the three largest figures given by Elrod in his "Biological Reconnaissance in the vicinity of Flathead Lake" (:02, pl. 27), over the name of *Pyramidula strigosa*, var. They are from McDonald Lake, Mission Mountains, Montana, which should not be confused with the lake of the same name in Glacier Park near the type locality of *apiarium*. Not any of the shells he figures on the plate cited appear to me to be correctly referred to *strigosa*.

Most of the living specimens taken were found to contain unborn young. The number of embryos per adult varied so greatly that it is evident the smaller numbers did not represent entire broods, probably the last members of a clutch in progress of birth. Twenty specimens from Station XV yielded from 2 to 18 embryos each, the average being 11.6. At Station XVI 12 specimens yielded from 3 to 23 embryos each, the average being 14.5. Where but few embryos were found they proved generally to be above the average in size, which accords with the supposition that in such cases parturition was more advanced.

The dead shells from Station V on the Arctic side of the Divide are not typical of the race as here described. The same would probably be true of those taken at Station VI, were any of them adult.

***Thysanophora ingersolli* (Bland).**

I do not recall having seen *Thysanophora* reported from so far north. However no special peculiarities have been detected in these specimens.

***Pyramidula cronkhitei* (Newcomb).**

Not found as commonly as would naturally have been expected.

***Punctum californicum* Pilsbry.**

This determination is due to Mr. Vanatta. The specimens are distinctly smaller, are much darker brown in color, and appear somewhat more coarsely striate than any Californian specimens of the species before me, and further, although the embryonic whorls are in both instances weakly spirally striate, they are much less distinctly so in the Montana form.

***Zonitoides arborea* (Say).**

Found commonly only in McDonald Creek Canyon; scattering specimens elsewhere.

***Euconulus fulvus alaskensis* Pilsbry.**

Wherever we went in the Park *Euconulus* was found not only to be ubiquitous but abundant.

Mr. Vanatta referred the shells sent him to typical *fulvus* rather than to *alaskensis*, but I am unable to effect a satisfactory separation of the remainder of the specimens from other Rocky Mountain *Euconulus* referred unquestioningly to the subspecies. Under a fairly high power (82 diameters), I can discover no trace of spiral sculpture on the earlier turns as in specimens of *fulvus* s. s. from Unity, Maine. Also there is "about one whorl more in shells of similar size"<sup>2</sup> for the Maine form, the color is noticeably paler, the axial sculpture finer, and the luster brighter.

***Polita binneyana* (Morse).**

This was found principally in connection with the same peculiar plant association as *Oreohelix cooperi apiarium*, and attention to this fact should lead to its discovery at many other Stations than those

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<sup>2</sup> Cf. Pilsbry and Ferriss, :10, p. 132.

at which we eventually ran across it, in which case it may prove to be of greater relative abundance than my figures indicate. The record is apparently a new one for the state.

***Polita chersinella* (Dall).**

There is a decided discrepancy in the respective descriptions and figures given of *chersinella* by Dall and Binney, and it is perhaps not yet just certain what *chersinella* really is. However that may be, I am unable to distinguish the present specimens from material taken in the Californian Sierras, in spite of the tremendous jump in range. Compared with a somewhat larger specimen of the latter taken near Lake Tahoe by Mr. Allyn G. Smith, the largest of the Glacier Park shells has about one-half a whorl more, has rather more evenly rounded whorls and aperture, and a rounder, flatter spire. The generic position here adopted for the species is at best doubtful, but I feel convinced that it is *not* a *Eucomulus*, a certain ease of confusing one's shells in the field with *E. f. alaskensis* notwithstanding. It has not been reported previously outside of California, where it is a characteristic alpine form.

***Striatura milium pugetensis* (Dall).**

One would naturally anticipate that these shells would fall in line with their Washington neighbor, *pugetensis*, rather than with the far eastern form, yet Mr. Vanatta considers them "not typical of the var." but "nearer the regular *milium*." With the first part of the opinion quoted I concur, but not with the second. The Glacier Park shells are not only larger on the average (major diameter 1.67-1.85 mm.) than any (e. g.) Maine or Massachusetts *milium* I have seen, but possess the *strong spiral sculpture* of the first whorl and a half which is one of the striking features of the otherwise weakly differentiated *pugetensis*. Nor is the beautiful silky sculpture of the later whorls, particularly the last, which one sees in New England specimens and which has been so carefully described and figured by Morse ('64, p. 19, pl. 2, fig. 7), at all so exquisitely developed in the western shells.

As compared with specimens of typical *pugetensis* from Seattle, the Montana shells are notably larger, flatter, and coarser in appearance, slightly approaching in some respects the giant southern *meridionalis* Pilsbry and Ferriss. It may be that one day this mountain race will require a name of its own. Meanwhile the record is a new one for the state.

***Vitrina alaskana* Dall.**

Noted frequently as indicated in the table, but nowhere observed in any abundance.

***Vertigo modesta parietalis* (Ancey).**

The shells of this series show considerable variation. In some cases a considerable proportion of the shells (a respectable minority of those from Station XII, and a large majority of those from Stations I, II, and IX) have the angular lamella reduced to a mere trace or obsolete, thus approximating the typical *modesta*. Somewhat less than a third of all the adult shells taken are of this type, the balance being distinctly 5-toothed shells, i. e., true *parietalis*.

This *Vertigo* is abundant at suitable stations all through such portions of the Park as were visited.

***Pisidium abditum* Haldeman.**

The specimens were hand picked from a small and very cold pool, but a few score feet from the partly frozen and perpetually frigid Iceberg Lake, at 6000 feet altitude, the highest elevation at which any Mollusca were obtained in the Park. Here they were abundant, and with a small sieve of the proper mesh many specimens could have been taken.

The specific determination is due to Mr. Vanatta.

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## EXPLANATION OF PLATES

(Note: The illustrations on Plate IX are from photographs by the author. The specimen figures on Plate X were prepared by Mr. John Howard Paine.)

PLATE IX.—Fig. 1.—St. Mary Lake and Going-to-the-Sun Mountain from Going-to-the-Sun Chalets. Station V is in the woods above the Lake in the right foreground.

Fig. 2.—McDermott Lake, Mount Wilbur, Upper Swiftcurrent Valley, and the Continental Divide, from near the lower end of McDermott Lake. Station IX is in the woods beyond the tepees in the right center. Station XII is at the far upper end of the valley around the mountain shoulder at the left of the picture. Station XI is high up at the base of the steep glacial cirque in the distance to the right of Mount Wilbur.

Fig. 3.—Iceberg Lake. Station XI is a small pool a few rods from where the picture was taken.

PLATE X.—*Oreohelix cooperi apiarium* n. subsp. Series of nine specimens from the type locality, Station XVI, Cat. 3613 (excepting the type), Berry Collection. The type (Cat. 4130) is the shell shown in Fig. 2-2b. All figures natural size.



## A PECULIAR VENEZUELAN LAND SNAIL.

BY HENRY A. PILSBRY.

*Xenodiscula venezuelensis* n. gen. and sp. Fig. 1.

The shell is minute, discoidal, being concave above and below, whitish-transparent, glossy, with sculpture of spaced radial grooves after the first half whorl. These grooves become closer near the aperture, and in the largest and freshest specimens they are occupied

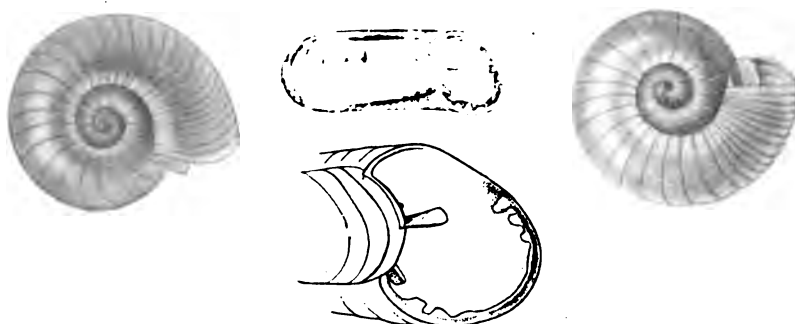


Fig. 1.—*Xenodiscula venezuelensis*. Three views of the shell, and aperture more enlarged.

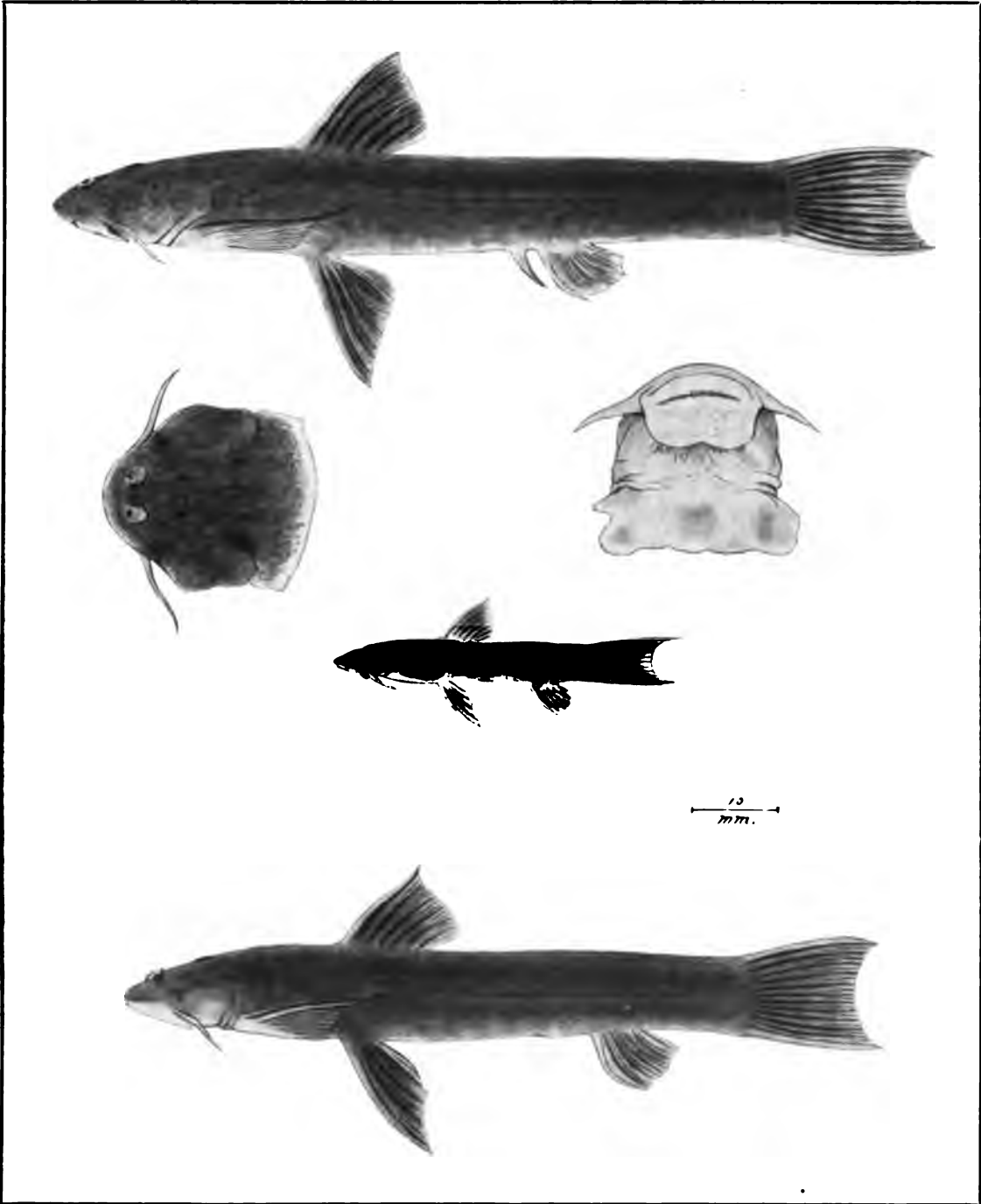
there by projecting riblets (which may be partly cuticular and deciduous). There are not quite three whorls, rapidly increasing, convex, most strongly so above. The aperture is oblique, wide, of irregular shape. On the parietal wall there is a high, thin median, emerging lamella, which penetrates only a short distance, and near the columella there is an oblique, much smaller lamella. The outer and lower margins of the lip are thickened within and toothed. On the columella there is a small blunt tooth followed by a more tapering one, with a low third prominence in fully adult shells. Within the outer lip, above the periphery, there is a group of three small teeth, the upper one largest, the other two sometimes lacking, or developed later.

Alt. 0.55, diam. 1.6 mm.

Cariaquita, Venezuela, S. Brown, Bond Venezuela Expedition, 1911. Type and paratypes, No. 105,209, A. N. S. P.

All of the specimens are empty shells, obtained by sifting leaf debris. The affinities of the species remain uncertain, as it is very unlike any described form, but it doubtless belongs to a new genus, which may provisionally be placed near *Proserpinula* or *Volvidens*, both Antillean genera.

In the type specimen there is a very minute lamella above the parietal, lacking in the other examples.



FOWLER: A NEW SILUROID FISH.



1



2



BERRY: MOLLUSCA OF GLACIER NATIONAL PARK.



NOVEMBER 18, 1919

The President, JOHN CADWALADER, A. M., LL. D., in the Chair.

One-hundred and forty-two persons present.

Dr. WITMER STONE made a communication on "A Naturalist's Camp in the Chiracahua Mountains of Southern Arizona," illustrated by lantern slides. (No abstract.)

The Publication Committee reported the receipt of the following papers for the PROCEEDINGS:

"A New Trout from the Mountain Streams of Formosa," by David Starr Jordan and M. Oshima.

"Notes on Tropical American Fishes," by Henry W. Fowler.

"Description of a New Siluroid Fish from Colombia," by Henry W. Fowler.

"Dipterological Notes and Descriptions," by Ezra T. Cresson, Jr.

"Mollusca of Glacier National Park, Montana," by S. Stillman Berry.

"New Genera of Fossil Fishes from Brazil," by David Starr Jordan.

"A Peculiar Venezuelan Land Snail," by Henry A. Pilsbry.

Nominations for Officers, Councillors, and members of the Committee on Accounts were made.

The deaths of Thomas Skelton Harrison, J. Ewing Mears, William C. Stevenson, Jr., George B. Cresson, and Miss Harriet Blanchard, members, and of Gustav Retzius and Ernst Haeckel, correspondents, were announced.

Miss Anne Hinchman, Walter Palmer, W. H. Van Sickel, Arthur Cope Emlen, and Hampton L. Carson, were elected members.

The following paper was ordered to be printed:

## NEW GENERA OF FOSSIL FISHES FROM BRAZIL

BY DAVID STARR JORDAN

In the year 1909, through the courtesy of Dr. John C. Branner, the collection of fossil fishes of the Serviço Geologico e Mineralogico do Brazil was sent to me for study by the late Orville A. Derby, then head of the Survey and director of the Museu Nacional at Rio de Janeiro. For reasons, easily understood in these days of confusion, my report on these fishes has been delayed. As, however, reference is made to the new genera concerned in a forthcoming treatise by Dr. Branner on the geology of Brazil, it seems desirable to publish the three new genera named in this report.

The specimens concerned are of the Cretaceous age and came from Barra do Jardim, Serra do Araripe, at Ceará, Brazil, the locality from which Gardner secured for Agassiz the original specimens of several species. These examples, like those of Agassiz, were originally rolled on the beach between tide marks, each becoming the nucleus of a clay concretion.

We may note in this connection that *Notelops brama* (Agassiz) is identical with *Calamopleurus cylindricus* Agassiz. It should apparently stand as *Calamopleurus brama*. *Cladocylus gardneri* Agassiz is probably one of the Osteoglossidæ, and not related to the European species, *lewisiensis*, called *Cladocylus* by Agassiz and others.

## Family ELOPIDÆ.

**ENNELICHTHYS** new genus.

Type: *Ennelichthys derbyi* Jordan.

In the collection are two large skulls (No. 55 Jardim, and No. 57 Jardim, the latter with counterpart) of a large elopine fish evidently allied to the genus *Enneles* of Jordan and Branner. From the latter it is distinguished by its smaller mouth, the maxillary scarcely extending beyond eye, and by its excessively strong dentition, the anterior teeth in the lower jaws being long, sharp and fang like; those of the upper jaws similar but smaller.

**Ennelichthys derbyi** new species.

The species named *Ennelichthys derbyi* in honor of the late Orville Adelbert Derby, formerly a fellow student in Cornell University,

and later the head of the Serviço Geologico e Mineralogico do Brazil at Rio de Janeiro. The type of *Ennelichthys derbyi*, No. 55, is a head about 6 inches long, the left side somewhat crushed down, the right side intact, but more or less battered, especially posteriorly. Opercle battered, the subopercle not evident; bones of top of head rugose; preopercle broad, with radiating striae at angle; cheek covered by a large bone; two bones behind eye.

Mouth very large, very oblique, the lower jaw projecting; snout very short, about  $5\frac{1}{2}$  in head; eye 5 in head; maxillary  $2\frac{1}{2}$ , mandible about 2. Both jaws with long, sharp, fang-like teeth anteriorly, the longest in front of lower jaw about  $\frac{2}{3}$  to  $\frac{1}{2}$  diameter of eye, the next longest on sides of mandible, about 8 of these evident. Posterior teeth of both jaws rather smaller, and the upper teeth apparently smaller, than lower and more widely set, but no small teeth and no broad teeth visible anywhere. A pit filled with stone on each side corresponding to the nostril. While most of the teeth are lost, fang-like teeth are seen at intervals in both jaws.

**BRANNERION** new genus.

Type: *Calamopleurus vestitus* Jordan and Branner.

The species described by Jordan and Branner under the name of *Calamopleurus vestitus*, should form the type of a distinct genus of Elopidae, distinguished by the long anal fin which begins under the last ray of the dorsal, and the deep short body with correspondingly long ribs. The scales are large, but of the same character as in *Calamopleurus*, and the lateral line is well developed.

The genera of Brazilian Cretaceous Elopidae may be thus compared with the living genera:

- a. **ELOPINÆ**: Pseudobranchiæ large (in living species) scales relatively small; last ray of dorsal not prolonged; anal smaller than dorsal; base of caudal more or less scaly.
- b. Dentition even, the teeth slender and close-set; dorsal with a sheath of scales.
- d. Anal fin long, beginning under last rays of dorsal, its rays 15 or more; ventrals below or before dorsal; scales rather large, 20 in a cross series below dorsal; lateral line well developed. (Teeth unknown). *Brannerion*.
- dd. Anal fin short, beginning well behind dorsal.
- e. Ventrals inserted under last rays of dorsal.
- f. Body compressed; subopercle nearly as large as opercle; scales small, about 35 in a cross series; lateral line well developed in perfect specimens (obsolete in those poorly preserved). *Calamopleurus*.



- ff. Body cylindrical, fusiform, scales firm, more or less crenulate, about 25 in a cross series; no lateral line, opercle very large, convex, much larger than subopercle. *Rhacolepis.*
- ee. Ventrals inserted under first ray of dorsal; lateral line well developed; body elongate; teeth small, even. *Elops.*
- bb. Dentition uneven, but weak; mouth moderate, oblique; scales large; caudal fin with about 10 broad, much-branched rays. *Anædopogon.*
- bbb. Dentition uneven, some of the teeth large, canines robust.
- g. Maxillary extending far beyond eye; front of jaws with very broad teeth; posterior teeth in lower jaw small and even. *Enneles.*
- gg. Maxillary scarcely extending beyond eye; front and middle of lower jaw with very long fangs; no broad teeth. *Ennelichthys.*
- aa. MEGALOPINÆ: Pseudobranchiæ none; scales large, firm; anal fin larger than dorsal; last ray of dorsal produced into a long filament; postorbital bones very thin, membranaceous; teeth uniform; body compressed.
- h. Dorsal fin inserted above ventrals. *Megalops.*
- hh. Dorsal fin inserted behind ventrals. *Tarpon.*

Family ASPIDORHYNCHIDÆ.

**VINCTIFER** new genus.

The Brazilian Cretaceous species hitherto referred to *Belonostomus* differs from the type of the genus in the very much greater depth of the scales composing the lateral line. These are anteriorly about five times as deep as long. The jaws are also more robust than in the typical species.

In the type of the genus *Belonostomus* (*B. tenuirostris*) the jaws are excessively elongated and the scales of the lateral line are scarcely larger than the others. I propose to separate *Belonostomus comptoni*, and the European species allied to it, as a distinct genus which may be called *Vinctifer*. It is characterized by the very deep band-like scales along the sides, the relatively short jaws, and the relatively robust body.

December 16.

The President, JOHN CADWALADER, LL.D., in the Chair.

Twenty persons present.

Officers, Councillors, and members of the Committee on Accounts were elected for the ensuing year.

Annual Reports were received from the Recording Secretary, the Corresponding Secretary, the Librarian, the Curators, the Treasurer, the auditors of the Treasurer's accounts, the Treasurer of the *Manual of Conchology*, the Biological and Microscopical Section, the Entomological Section, the Botanical Section, the Ornithological Section, and the Curator of the William S. Vaux Collections; and a verbal report on the Mineralogical and Geological Section by MR. F. J. KEELEY.

The reception of the following papers was reported:

**MOLLUSCA FROM CENTRAL AMERICA AND MEXICO.**

BY HENRY A. PILSBRY.

Most of the forms described herein were collected by Mr. A. A. Hinkley during two visits to Guatemala. A few are added from various other localities, collected by Mr. S. N. Rhoads and others.

With the exception of *Neritilia*, a peculiar Neritid mollusk with a more specialized radula than others of its family, the species belong to genera already well represented in Mexico and Central America.

*Salastella hinkleyi* n. sp. Fig. 2.

The shell is cylindric with tapering spire, glossy, finely, arcuately striate, with numerous irregularly spaced grooves indicating former peristomes. First three whorls rather slowly widening, after which the suture descends more rapidly, oblique to the previous whorls, each succeeding whorl at least double the width of that above it. The last whorl is flattened laterally. Aperture half the length of the shell. Outer lip arching very strongly forward in the middle. Columella very deeply concave above the truncation.

Length 8.5, diam. 3 mm.;  $5\frac{1}{2}$  whorls.

Mountain side near the Tamosopo Sugar Company's place, San Luis Potosi. Also at El Abra.

This species changes so much with age that without a good series one would not readily connect the half-grown and the mature stages. After the third whorl the suture descends very rapidly, and the aperture becomes shorter in comparison with the total length. Moreover, the deep, arcuate grooves which characterize the fully adult shell are far weaker and less numerous in specimens of 6 mm. length or smaller.

It is closely related to *S. joaquina* Strebel, but adult specimens of the same length have a half whorl more and a shorter aperture. Probably the specimens from Diente, near Monterey, Nuevo Leon, referred to *joaquina* are immature *S. hinkleyi*.

16 specimens were taken at El Abra, the largest measuring, length 6, diam. 2 mm. The aperture is decidedly over half the total length at this stage. It is quite possible that the largest shell from the type locality (fig. 2) is an exceptionally large and old individual.

A review of the species of *Salasiella* known up to 1907 was given in the Manual of Conchology XIX, pp. 170-174. Since that time *S. browni* Pils., of the Canal Zone, has been described.

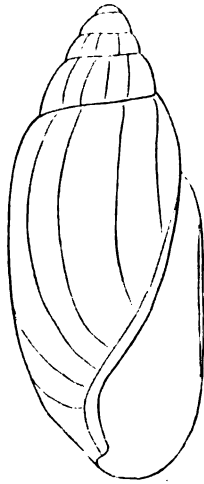


Fig. 1.  
*Salasiella*  
*guatemalensis*.



Fig. 2.  
*Salasiella*  
*hinkleyi*.

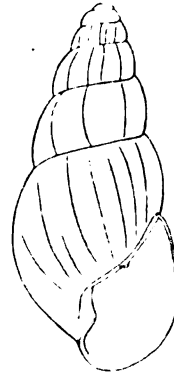


Fig. 3.  
*Leptinaria livingstonensis*  
Hinkley.

***Salasiella guatemalensis* n. sp. Fig. 1.**

The shell is oblong, pale yellowish, glossy, with fine, unequal growth-ripples. Spire rather short, conic, the apex obtuse. Whorls convex, the third hardly wider than the second, the rest rather rapidly widening, the last somewhat compressed laterally. Aperture more than half the total length. Outer lip strongly arching forward. Columella concave as usual.

Length 9.9, diam. 4, length of aperture 5.6 mm.;  $5\frac{1}{2}$  whorls.

Gualan, Guatemala, S. N. Rhoads. Type and paratypes, No. 114,838, A. N. S. P.

This species stands near *S. browni* of the Canal Zone, but is stouter with shorter spire.

A few specimens, not fully mature, were taken by Mr. Hinkley at Jocolo.

***Spiraxia livingstonensis* n. sp. Pl. XI, fig. 1.**

The shell is subulate, its diameter contained 3.7 times in the length, very pale yellow, composed of  $9\frac{1}{2}$  rather strongly convex

whorls. First  $2\frac{1}{2}$  whorls are smooth, following whorls sculptured with axial (vertical) ribs less than half as wide as their intervals, about 44 on the penultimate whorl. The upper ends of the ribs project, crenulating the suture. Aperture ovate; columella a little thickened, moderately sigmoid.

Length 9.25, diam. 2.5, aperture 2.3 mm.

Mountains west of Livingston, Guatemala (A. A. Hinkley).

This species is related to *S. sulciferus*, but it has less crowded, thinner ribs.

*Spiraxis longior* n. sp. Pl. XI, fig. 2.

The shell is subulate, very slender, the diameter contained about 3.8 times in the length, composed of  $9\frac{1}{2}$  moderately convex whorls, of which the first  $2\frac{1}{2}$  are smooth; apex obtuse; subsequent whorls sculptured with axial (vertical) ribs, which are just perceptibly sinuous, almost straight, and nearly as wide as their intervals. There are about 35 ribs on the penultimate whorl. On the last third of the last whorl the ribs become a little weaker in fully adult shells. Aperture ovate. Columella thin, weakly sinuous.

Length 8, diam. 2.1, length of aperture 2 mm.

Mountains west of Livingston, Guatemala (A. A. Hinkley).

A very slender form with small aperture, only one-fourth the length of the shell.

*Pseudosubulina martensiana* n. sp. Pl. XI, fig. 3.

The shell is slender, a little attenuated near the obtuse apex, corneous-buff, composed of 9 whorls, the first three strongly convex, the convexity diminishing subsequently, the later whorls being flattened, convex only near the sutures. The initial  $\frac{3}{4}$  whorl projects and is smooth; the next two whorls are of about equal diameter, with sculpture of widely spaced axial ribs; on subsequent whorls the ribs are close, rounded, and as wide as their intervals, 40 standing on the penultimate whorl. On the last whorl the ribs disappear on the base, which is smooth. Apertures rhombic; columella moderately concave, deeply excised at the base.

Length 11, diam. 3, length of aperture 3 mm.

Mountains west of Livingston, Guatemala (A. A. Hinkley).

In the related *P. lirifera* Morel. the columella is represented as deeply concave, and there are more smooth whorls at the summit. Whether the shell described and figured as *P. lirifera* by Professor von Martens is really the species of Morelet is not quite certain.

**Guppya elegantula** n. sp. Fig. 4.

The shell is narrowly perforate, pyramidal, resembling *G. elegans* (Strebel) in form; pale cinnamon, fading at the summit. Surface

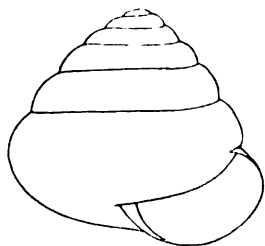


Fig. 4.

above the periphery having a microscopic sculpture of fine, close, nearly vertical striae, cut by equally close spiral lines, but the latter are not everywhere developed; the base glossy, with engraved spirals only, far more widely spaced than on the upper surface. Outlines of the spire are slightly convex. Whorls quite convex, the last rounded peripherally in the adult stage (angular in the young).

Aperture semilunar, not very wide.

Alt. 3.2, diam. 3.3 mm.;  $6\frac{1}{2}$  whorls.

State of Vera Cruz, Orizaba, 500 ft. above the town (Heilprin exped.). San Luis Potosi, canyon and falls below Valles (Hinkley, type loc.). Nuevo Leon, Diente near Monterey (S. N. Rhoads). Tamaulipas, in a canyon 4 miles west of Victoria, at about 3000 ft. (S. N. Rhoads.)

This is the species which was formerly identified as *G. elegans* (Strebel) by the writer. It is nearer that than to any other described species of the region, but on account of the smaller size, in some hundreds of specimens, the identification was not satisfactory. Specimens of the real *elegans* have now turned up, found in a vial labelled *H. selenkai*, from Mirador, one of the localities given by Strebel for *elegans*. It is a decidedly larger shell than the present species, probably confined to a warmer zone.

Specimens from Uruapam and other places in the State of Michoacan (S. N. Rhoads, 1899), have closer spirals on the base. A single immature specimen from Yautepec, Moreles (Heilprin exped.) probably belongs here. It was recorded by the writer as *elegans*.

*G. elegantula* was collected at Guadalajara, Jalisco, by McConnell and Crawford, 1909. It was taken in river drift at Tampico by Mr. Hinkley, but may have floated there from inland. It appears to be common and widely distributed.

A closely related form having about one whorl less, and with the aperture a little wider, was taken by Mr. Hinkley about old logs in the banana plantation, Maya farm, Quirigua (No. 28 of his 1913 collection). It is more highly conic than *G. pittieri* v. Marts., and may perhaps be a new species between *pittieri* and *elegantula*, or a subspecies of the latter.

*Guppya gundlachi* (Pfr.) was taken by Mr. Hinkley at Tampico and near San Dieguito, San Luis Potosi, and at the Maya Farm, Quirigua, Guatemala.

***Guppya jalisco* n. sp.** Pl. XI, fig. 6.

The shell is minute, umbilicate (the umbilicus small, round, about one-ninth the diameter of the shell), light brown, somewhat glossy, very minutely striate, the striae decussated by close, microscopic spirals on the spire. The spire is somewhat dome-shaped, the outlines convex, summit obtuse. The whorls are closely coiled, nearly equal, very convex, the last one rounded peripherally and convex below. Aperture rather narrow, somewhat lunate. Columellar margin a little dilated.

Alt. 1.7, diam. 1.9 mm.; 5 whorls.

Guadalajara, Jalisco, Mexico. Type, No. 44,839 A. N. S. P., collected by R. A. McConnell, 1909.

A very small, compactly coiled shell, much smaller than *G. elegantula*.

***Pseudohyalina maya* n. sp.** Pl. XI, figs. 5, 5a.

The shell is very minute, shaped much like *Z. nitida* (Müll.); pale yellow; openly umbilicate, the width of umbilicus somewhat more than one-fourth of the diameter of shell. Surface glossy, showing very faint growth lines under the microscope, but without spirals. Whorls well rounded, slowly increasing. Aperture lunate, somewhat oblique.

Alt. 1.1, diam. 1.75 mm.; very nearly 4 whorls.

Maya farm, Quirigua, Guatemala (A. A. Hinkley). Type and paratypes, No. 107,511 A. N. S. P.; also in coll. Hinkley.

This form is smaller than *Hyalinia permodesta* var. *minor* v. Martens.

***Pseudohyalina opal* n. sp.** Pl. XI, figs. 7, 7a.

Shell very minute, corneous, smooth except for faint lines of growth, having a somewhat silky luster above, glossy beneath; rather narrowly umbilicate, the width of umbilicus contained about  $6\frac{1}{2}$  times in the diameter of the shell. Whorls  $4\frac{1}{4}$ , convex, the last well rounded; suture compressed, narrowly margined. Aperture lunate.

Alt. 1.2, diam. 1.95 mm.

Polvon, Nicaragua. Types, No. 48,523 A. N. S. P., collected by the McNeil expedition.

This little shell has been in the collection for many years under the name "*H. opal* McNeil Ms." It is more narrowly umbilicate than *Z. maya*, with the last whorl wider, viewed from above.

*Averellia* (*Trichodiscina*) *hinkleyi* n. sp. Fig. 5.

The shell is broadly and openly umbilicate, discoidal, the spire sunken a little; between cinnamon and cinnamon-brown, not banded.

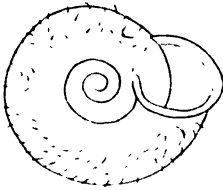


Fig. 5.—*Averellia hinkleyi*.

Surface · dull, very densely and minutely papillose, and sparsely covered with long hairs arranged in oblique lines. These hairs are about 0.75 mm. long and about 1 mm. apart.

On the penult whorl they persist in the sutural region only, and the first  $1\frac{1}{2}$  whorls are smooth, without papillæ or hairs. The whorls are convex, the last rounded peripherally, the periphery above the middle; very deeply descending in front. The aperture is sub-horizontal. Peristome pale vinaceous, narrowly reflected, the insertions of the lip remote, parietal callus very thin.

Alt. 5, diam. 12.3 mm.; width of umbilicus 3.7 mm.; of aperture 5 mm.;  $4\frac{1}{2}$  whorls.

Mountains west of Livingston, Guatemala, A. A. Hinkley, 1913. Type and paratype, No. 107,533 A. N. S. P.

Distinct by its concave spire, very deeply descending last whorl and long hairs. The form and peristome are much as in *A. macneili* (Crosse), but there is no trace of the peculiar pits of that species.

*Thysanophora rhoadsi* n. sp. Fig. 6.

The shell is perforate, conic, light brown, dull. The spire is high, a little convexly conic. Whorls very convex, the suture deeply impressed. Sculpture of light, fine, somewhat oblique growth wrinkles, with much more strongly retractive cuticular raised threads superposed over them, but mainly worn from the type specimen. The last whorl has rather strong, irregular growth-wrinkles, and only slight traces of the retractive threads. The aperture is oblique, broad, columellar margin reflected.



Fig. 6.

*Thysanophora rhoadsi*.

Alt. 2.8, diam. 2.5 mm.; 5 whorls.

Gualan, Guatemala, collected by S. N. Rhoads. Type, No. 114,836 A. N. S. P.



It is related to *T. cœcoides* (Tate), but differs by the more elevated shape, the altitude exceeding the diameter.

***Drymaeus dombeyanus* (Pfr.).**

In a variety from Guadalajara, Jalisco, the last 2 or  $2\frac{1}{2}$  whorls are white, the preceding 2 having some indistinct brown spots; lip and interior white; the spire is longer and aperture smaller than in the typical form.

Length 55, length of aperture with peristome 33 mm.; nearly 7 whorls.

Another variety from the same neighborhood resembles *D. dunkeri forreri* (Mouss.) in shape and coloration, but has the coarse sculpture of *dombeyanus*. It is streaked copiously with dull purplish brown, with scattered whitish spots on the streaks. Lip broadly expanded, as in *dombeyanus*. This variety may be called *D. dombeyanus ornatus*.

Length 41, diam. 22, aperture 24 mm.

" 43 " 26 " 27 "

***Brachypodella subtilis pulchella* (Martens).**

This shell, which Mr. Hinkley has obtained in large numbers in the mountains west of Livingston, Guatemala, is not a form of *B. morini* as I formerly supposed. It is closely related to *B. subtilis* (Morel.), from which it differs by the smaller size and decidedly stronger sculpture. As in *B. subtilis*, the early whorls are smooth, while in *B. morini* they are finely striate. *B. subtilis*, of which I have an author's specimen, was described from northern Guatemala, and *pulchella* from Livingston.

***Succinea panamensis* n. sp. Pl. XI, fig. 4.**

The shell is narrowly ovate with produced spire, pale yellow, not very glossy, with uneven sculpture of striæ and low folds. Whorls  $2\frac{3}{4}$  to nearly 3, those of the spire convex, the last whorl weakly convex above, strongly so below the periphery. Aperture symmetrically ovate.

Length 13.3, diam. 4.5, length of aperture 5.7 mm.

Panama (Capt. Field); Las Cascades, C. Z. (Dr. A. P. Brown, 1910). Type and paratypes, 48,522 A. N. S. P.

I formerly identified this as "*S. recisa* Morel.?", but having now seen specimens of Morelet's species from the type locality, it is easy to see that the Panamic species is different. There are 26 specimens in the two lots, the largest 14.6 mm. long. As I cannot exactly match the form with any of the numerous Central American or Mexican species, it seems best to describe it as new, in order to have a name for the particular form of the Canal Zone.

**Vaginulus moreleti** C. & F.

Jocolo and Esmeralda Plantation, Rio Dulce, Guatemala (A. A. Hinkley).

**Physa solidissima** n. sp. Pl. XI, fig. 8.

The shell is imperforate, subglobular with very short spire, very thick and solid, composed of  $4\frac{2}{3}$  whorls, the last one a little fuller above, convexly tapering downwards. Aperture semicircular; outer lip evenly arcuate, thick. Columella very heavy, with a low thick fold or convexity in the middle.

Length 8.2, diam. 6.3, length of aperture 6.9 mm.

Guadalajara, Jalisco, Mexico (McConnell and Crawford).

This is very unlike any American species I have seen, not only by its extreme solidity, but also by the very short contour. The surface is marked by a few growth-lines, but the minute sculpture, if any, and the color, cannot be ascertained until fresh specimens come to hand.

**Planorbula obstructa** (Morelet).

In a reservoir four miles north of Guatemala City, Mr. Hinkley took a large series of shells agreeing with the small typical form of *S. obstructa* except in the absence of internal "teeth" in the great majority of specimens, though a few show them. This form, which may be called mutation *anodonta*, is analogous to *S. dentiens* var. *cannarum* Morel. It measures 5 to 6 mm. in diameter and has only 4 whorls. There are also several other lots in the collection of the Academy, from places between Guatemala and Panama.

**NERITILIA** v. Martens.

The shell is neritiform, with smooth columellar margin. Operculum with, on the calcareous internal face, a raised ledge along the

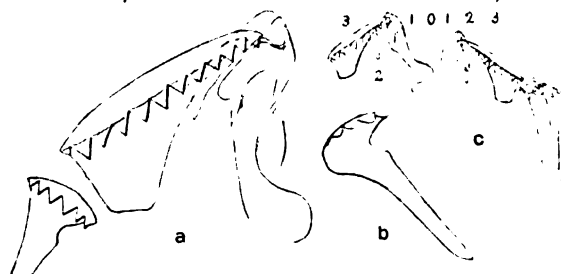


Fig. 7.—Teeth of *Neritilia*. A, lateral teeth of one side, with part of the first uncinus. B, the first uncinus lying flat, the cusps foreshortened. C, laterals of both sides with four uncini; 1, 2, 3, first, second and third or major laterals.

basal and columellar edges, rising in a point or "peg" but without a distinct "rib." Radula with no central tooth, three laterals on each side, the outer one, or major lateral, large, oblique,

with serrate cusp. Uncini or marginal teeth are extremely numerous with wide, short, serrate cusps. Genotype, *N. rubida* Pse.

The operculum is unlike that of any known Neritid snail, but the chief peculiarity of the genus is in the radula. There is no central tooth whatever, the arrangement being as figured by Fischer for *Neritopsis*, the formula being  $\infty-3-0-3-\infty$ , that of *Neritina* and *Nerita* being  $\infty-4-1-4-\infty$ . The large inner lateral tooth is low, of very irregular form, without cusp. and hard to see on account of its low relief. The second lateral is also low, narrow, without cusp, and interlocking with the larger lateral. The major lateral (*Hut* or *Schirmplatte* of German authors) resembles somewhat that of *Neritina reclinata* as figured by Troschel. The uncini are exceedingly numerous. Only the inner ones are drawn in the figure (fig. 7).

While the shell has some resemblance to that of *Lepyrium*, the operculum and radula are very different, and strikingly unlike *Neritina* (or *Theodoxus*).

*Neritilia succinea guatemalensis* subsp. Fig. 8.

The shell is Neritiform, hemispherical, solid, buff, the spire projecting very slightly. Embryonic shell very small, glossy; subsequent whorls not quite 2, rather dull, and smooth except for faint growth lines and on the latter part some impressed lines. The aperture is semi-circular, yellowish and smooth within, the lip sharp. The columellar margin is straight without teeth or notches. Callus flattened and plain, not very extensive, whitish towards the edge.

Alt. 3, greatest (oblique) diam. 4.7 mm.

Alt. 4, greatest (oblique) diam. 5 mm.

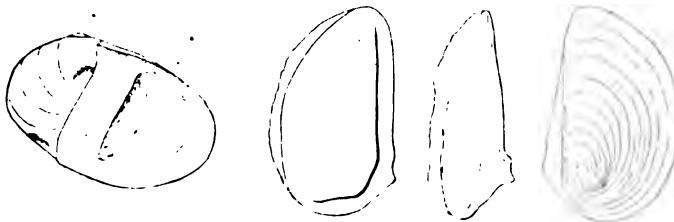


Fig. 8.—*Neritilia succinea guatemalensis*, shell and three views of operculum, the middle one an oblique view of the inside from the outer edge, showing greatest height of the ledge.

The operculum is slightly reddish towards the outer margin, a little concave, marked with growth lines, the nucleus near the basal end of the straight edge. The interior face is covered with a calcareous layer except for a reddish border along the outer arc. The basal and columellar margins have a raised ledge, which rises in a rather high summit at the basal end of the straight columellar edge; this

prominence is probably homologous with the peg of ordinary Neritid opercula, and the very slight projection above and connected with it may be the remnant of a rib. At each end there is an impressed scar of attachment.

Cavech River, Guatemala, at or near high tide, rare: found with *Neritina virginea* and *N. punctulata*, the latter in abundance. Collected by A. A. Hinkley.

The process of the operculum is so much shorter than that of *N. succinea* that we have possibly a new species; but very few have been examined.

***Schasicheila hinkleyi*, n. sp. Figs. 9, 10.**

The shell resembles that of *S. pannucea* Morelet except that it is larger. It is thin, between chamois and cream-buff when clean; densely clothed with subequal spiral cuticular threads. The last whorl is indistinctly angular in front. The lip is somewhat ex-

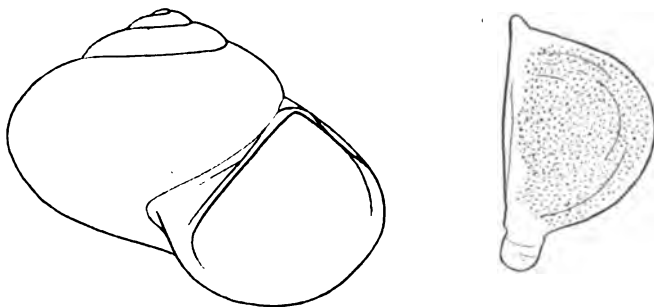


Fig. 9.—*Schasicheila hinkleyi*, shell and operculum.

panded, rather deeply notched above (about as in *S. pannucea*). The straight inner margin forms a raised ledge.

Alt. 8.5, diam. 11 mm.;  $3\frac{1}{2}$  whorls.

The operculum has a short, obliquely projecting process at the upper, and a long one, parallel to the straight margin, at the lower angle; the concave outer face is papillose.

Chama, Guatemala, collected by A. A. Hinkley.

The operculum of *S. pannucea*, as figured by Fischer and Crosse, has no superior projection, and the lower process is far shorter than in this species.

***Cyrenoida guatemalensis* n. sp. Pl. XI, fig. 9.**

The shell is orbicular, rather plump, whitish under a very pale brown cuticle. Sculpture of very fine concentric striae with thin cuticular edges. It resembles *C. floridana* Dall except that the hinge plate is shorter and wider anteriorly, and the posterior end

of the shell is well rounded, while in *floridana* it is indistinctly truncate. The interior has numerous small solid lumps. The beaks are smooth.

Length 8.7, alt. 8.3, diam. 5.2 mm.

Livingston, Guatemala, A. A. Hinkley, 1913. Type, No. 107,532, A. N. S. P.

***Eupera yucatanensis minima* n. subsp.**

The shell resembles *E. yucatanensis* in contour, having a very narrow anterior and broad posterior end; of a uniform buff-corneous tint, sometimes (seven out of thirty-one specimens examined) maculate with dark gray. It differs from *E. singleyi* by the narrower anterior end and the more projecting beaks.

Length 5, alt. 3.3, diam. 2.5 mm.

Valles river, Valles, State of San Luis Potosi, Mexico, on the under side of rocks in shallow water, where there is a strong current in mid-stream (A. A. Hinkley).

Probably a distinct species. *E. yucatanensis* measures: length 10, alt. 7, diam. 5 mm.

***Donax mediamericana* n. sp. Pl. XI, fig. 10.**

A species related to *D. striata* L., from which it differs by being smaller, comparatively longer, the alt. being three-fifths of the length; the angle between the anterior dorsal border and the posterior keel is decidedly and constantly larger; the anterior end is longer and tapers rapidly. The beaks are at the posterior four-tenths of the length. The keel is not so strongly expressed as in *D. striata*, and the posterior area is much more convex. The surface is shining, sculptured about as in *D. striata*. There are many radial riblets on the posterior end and extending on the valve about to the middle, whence they diminish gradually to the anterior end. The anterior-dorsal slope is almost smooth. The riblets crenulate the basal edge near the posterior angle, but less strongly than in *D. striata*. The teeth resemble those of *D. striata* except that the laterals are lower and much less robust.

The color is variable: white throughout; pink with concentric zones of a deeper shade, the interior pink, often violet at the ends; yellow, the interior white or pink and white, with violet ends; or yellow with dull bluish zones and beaks, the interior deep violet.

Length 22. alt. 12.5, diam. 7.9 mm. cotype.

"	21.5,	"	13.	"	7.9	"	"
"	24.9,	"	15.	"	8.3	"	"
"	25.	"	14.9,	"	9	"	"

Livingston, Guatemala, collected by A. A. Hinkley. Type and cotypes, No. 45178 A. N. S. P.

This species was collected in considerable quantity by Mr. Hinkley; but although locally common, and belonging to a group in which species usually have a wide distribution, I have been unable to trace this shell in the literature. It is certainly distinct from *D. striata*, the common *Donax* of the Mosquito Coast. It resembles Roemer's figures of his *D. siliqua*, from an unknown locality, but in that species the beaks are more posterior (at the posterior fourth), and the posterior carina is therefore steeper; the posterior area is somewhat granulose and its outline more convex. Moreover, the teeth differ. None of the new forms in Bertin's monograph (Nouv. Arch. du Mus.) is nearly related.

NOTE.—Since this article was in type I have found that Schepman, in his *Prosobranchia* of the Siboga Expedition, Part I, 1908, p. 13, has already noticed the peculiarities of *Neritilia*, and figured the teeth of *N. rubida*, from Celebes. It is interesting to find American species with a similar radula.

#### EXPLANATION OF PLATE XI.

- Fig. 1.—*Spiraxis guatemalensis* n. sp.
- Fig. 2.—*Spiraxis longior*, n. sp.
- Fig. 3.—*Pseudosubulina martensiana* n. sp.
- Fig. 4.—*Succinea panamensis* n. sp.
- Figs. 5, 5a.—*Pseudohyalina maya* n. sp.
- Fig. 6.—*Guppya jalisco*, n. sp.
- Figs. 7, 7a.—*Pseudohyalina opal*, n. sp.
- Fig. 8.—*Physa solidissima* n. sp.
- Fig. 9.—*Cyrenoida guatemalensis* n. sp.
- Fig. 10.—*Donax mediamericana* n. sp.

## SCROPHULARIACEÆ OF THE SOUTHEASTERN UNITED STATES

BY FRANCIS W. PENNELL.

The present revision of the species of the Scrophulariaceæ occurring in the southeastern portion of the United States, from North Carolina to Florida and westward to the Mississippi River, is the outgrowth of a long-continued and especial interest. Nearly fifteen years ago, when the writer was a student in the Botanical Section of The Academy of Natural Sciences of Philadelphia, certain problems in this field appeared, and have waited for the solutions now proposed. Perhaps this early connection will make more fitting the appearance of this paper in these PROCEEDINGS.

During the late summers and early autumns of 1912 and 1913, I collected extensively through every state of this area. This was in pursuit of a monographic study of the genera now called *Macranthera*, *Dasistoma*, *Afzelia*, *Aureolaria*, *Agalinis* and *Otophylla*. Nearly every species was found, and descriptions made of the form and color of the corolla of each. Later, almost every herbarium of significance for these species has been reviewed, and the results are presented with some confidence. A preliminary paper, dealing with the species of the Coastal Plain, was published in the "Torrey Bulletin" in 1913, and a summary of this group for North America is now awaiting publication in the Contributions from the Botanical Laboratory of the University of Pennsylvania.

In the course of these two trips many collections were made of the nearly related *Buchnera*, and, less consistently, attention was given to other genera of the family. But, to obtain field-descriptions and to collect for the first time the spring-flowering species, another trip was necessary. In the Spring of 1917 I traveled as far south as Key West, and from the Coast into the Appalachians. The expedition was peculiarly successful, so that now, excepting for a few local species of the lowland, as *Herpestis rotundifolia* and several of *Agalinis*, or of the upland, as *Ilysanthes saxicola* and *Penstemon smallii*, or of the mountains in late summer, as *Chelone lyoni*, practically every species has been described from flowering plants.

Excluding *Agalinis* and its allies, specimens preserved in eastern herbaria only have been reviewed. I have studied all in the her-

baria of The New York Botanical Garden, the Brooklyn Botanic Garden, The Academy of Natural Sciences of Philadelphia, the University of Pennsylvania, the United States National Museum, (including the former Biltmore Herbarium), and the Charleston Museum. In all institutions I have received the kindest attention and assistance.

The present revision follows a plan which should lead to a simple and helpful presentation of our taxonomic knowledge of this family within the area considered. Keys are given throughout, and these are made so ample as to include all features of evident contrast noted. Effort is made to group species and genera according to real relationship, hence giving the keys a phylogenetic value. To accomplish this, and to show what appears to have been the evolutionary progress within this family, a rearrangement of the whole has been made. This was first attempted in my "Scrophulariaceæ of the Local Flora,"<sup>1</sup> but the placing of the Gratioleæ as introductory to the genuine Scrophulariaceæ now appears to me more satisfactory. While of theoretic suggestiveness, it is hoped that these keys may prove of practical service.

Synonymy is given, so far as to explain the origin and application of each specific and varietal name used, and to account for every such name ever proposed from within this area. The original statement as to the type or to typic distribution is quoted, and consequent discussion is given. Practically all typic or isotypic<sup>2</sup> material known to occur in this country has been verified, and in *Agalinis* and allies much of that abroad. Especially rich in types are the herbaria of The Academy of Natural Sciences of Philadelphia, where Nuttall's and de Schweinitz's plants are preserved, and of the Charleston Museum, containing Elliott's collection.

The statements of distribution, variability, season of flowering and of fruiting, corolla-color, and other comment scarcely need explanation. For *Agalinis* and allies, which I have collected repeatedly and over a wide range, my forthcoming monograph will give a more detailed analysis of the range of each species. At present for all species I am stating range in general terms, and shall trust to receive corrections from workers who find this treatment partial or erroneous. The detailed noting of corolla-color will be of interest to students in the field. In every case, unless otherwise stated,

<sup>1</sup> Torrey 19: 109-114. 1919.

<sup>2</sup> The word "isotype" is used to designate a specimen of the original collection, other than the type itself. See Torrey 19: 13. 1919.



this has been recorded from notes made with fresh flowers before me.

A last insertion may require more justification. This is of the collection-numbers of the specimens made by me, grouping these by states. While not attempting to list collections, because of space-limitation, it does seem advisable to present this series, showing specimens considered authentic. For *Agalinis* and allies my forthcoming monograph will state fully the herbaria in which each may be consulted; for these and for the other genera, the numbers between 4,000 and 6,000 may be seen in the herbarium of the University of Pennsylvania at Philadelphia and numbers between 9,000 and 10,000 in that of the New York Botanical Garden. Duplicates are in many collections.

Corolla with the posterior lobes external in the bud.

(ANTIRRHINOIDEÆ.)

Tree. Leaves cordate, 15-20 cm. long. Inflorescence a panicle. Sepals leathery, clothed with stellate hairs. Corolla 50-60 mm. long. Capsule 40 mm. long, with broadly winged overlapping seeds.

I. PAULOWNIÆ.

Herbs. Leaves smaller. Sepals membranous (with stellate hairs only in *Verbascum*.) Corolla smaller. Capsule smaller, and seeds not overlapping.

Capsule septicidal or loculicidal by a simple median slit, the septum rupturing or deciduous. Corolla not spurred.

Corolla not saccate anteriorly, not horned.

Stigma two-lipped. Leaves usually more or less glandular-punctate. Pedicels frequently bibracteolate.

II. GRATIOLEÆ.

Stigma capitate. Leaves not glandular-punctate. Pedicels not bracted (or with a varying number of bractlets in *Chelone*).

Filaments five. Capsule without placental hairs. Leaves opposite, ternate or alternate, with blades much wider than the stem.

Corolla rotate, slightly zygomorphic, its lobes much longer than the tube. Filaments all with fertile anthers. Leaves alternate.

III. VERBASCEÆ.

Corolla tubular-campanulate, zygomorphic, its lobes shorter than the tube. Posterior filament without anther, the others didynamous. Leaves opposite or ternate.

IV. CHELONEÆ.

Filaments four. Capsule filled with tortuous hairs, between which are the scattered seeds. Leaves in fours, sixes or eights, with rudimentary blade which is narrower than the stem. V. RUSSELIÆ.

Corolla saccate anteriorly, and with a fine horn at the base of the anterior lobes. Leaves opposite.

## VI. ANGELONIEÆ.

Capsule loculicidal, the septum and adjacent capsule-wall persisting, the remaining wall splitting irregularly. Corolla with a spur at the base of the anterior petal. Leaves alternate.

## VII. ANTIRRHINEÆ.

Corolla with the anterior lobes external in the bud. Herbs.

## (RHINANTHOIDEÆ.)

Stamens two, the postero-laterals present, the antero-laterals completely lost. Antero-lateral lobes of corolla external in bud. Not parasitic. Sepals four, the posterior lost. Posterior lobes of corolla completely united.

## VIII. VERONICEÆ.

Stamens four, didynamous, the antero-laterals usually slightly the longer. Usually, perhaps always, parasitic on the roots of other plants.

Sepals five, alike, more or less united. Corolla-lobes all somewhat distinct, the two posterior spreading or broadly arched; anterior lobe external in the bud.

## IX. BUCHNEREÆ.

Posterior sepal shorter or wanting. Corolla decidedly two-lipped, the posterior lobes united and arched nearly to apex, the anterior lobes usually shorter; anterior or one antero-lateral lobe external in the bud.

## X. RHINANTHEÆ.

## I. PAULOWNIEÆ

1. *Paulownia*.

## II. GRATIOLEÆ.

Leaves alternate. Stamens five. Corolla essentially regular. Pedicel not bibracteolate.

2. *Capraria*.

Leaves opposite. Stamens four or two (the posterior stamen lost). Corolla more or less zygomorphic.

Leaves entire to serrate. Seeds brown or yellow.

Seeds reticulate. Corolla with the ridges to the antero-lateral sinuses low and not projecting beyond those points (so anterior filaments simple). Posterior lobes of the corolla little, if at all, shorter than the anterior.

Leaves uniform. Capsule longer than wide, acute or obtuse, its dehiscence septicidal, or septicidal plus loculicidal.

Sepals all alike. Pedicels never bibracteolate. Stamens four. First splitting of capsule loculicidal.

Corolla white, rotate, 3-5 mm. long, densely hirsute within over bases of all lobes; lobes longer than tube, the two posterior united throughout. Sepals four, distinct. Lips of stigma united, but line of union stigmatic. Placentæ fused with septum. Upper leaves alternate.

3. *Scoparia*.

Corolla lavender, personate, 20–35 mm. long, pubescent within below bases of the anterior lobes; lobes shorter than tube, the two posterior united about three-fourths length. Sepals five, united over one-half length. Lips of stigma distinct. Placentæ wide, peltate in cross-section, attached by a narrow line to the septum. Leaves all opposite.

4. *Mimulus*.

Sepals unequal, all distinct. Pedicels frequently bibracteolate. First splitting of capsule septicidal. Pedicels bibracteolate at base. Stamens four. Corolla pubescent within at base of posterior lobes.

5. *Mecardonia*.

Pedicels bibracteolate at apex or not at all.

Erect. Outer sepal not more than twice the width of the innermost. Corolla 8–20 mm. long, with tube much longer than the lobes. Pedicels bibracteolate. Postero-lateral stamens fertile, the antero-laterals rudimentary or wanting.

Corolla-tube broad, within densely pubescent on the posterior side. Sepals of nearly uniform length. Plants relatively lax or succulent, the leaves and sepals plane.

6. *Gratiola*.

Corolla-tube very narrow, within uniformly short-pubescent on all sides. Sepals very unequal in length. Plant stiff, the leaves and sepals revolute.

7. *Sophronanthe*.

Extensively repent. Outer sepal over twice the width of the innermost. Corolla 3–11 mm. long, with tube little longer than the lobes.

Stamens four. Corolla 7–11 mm. long. Outer sepal not deeply cordate nor conspicuously reticulate.

Corolla glabrous within, the throat yellow, the lobes white; posterior lobes distinct. No hypogynous bristles. Outer sepal oval or ovate, scarcely exceeding the oblong or lanceolate innermost. Capsule over one-half as broad as long. Leaves widening distally, very entire. Pedicels reflexed in fruit. Plants inodorous.

Stem pubescent. Leaves spatulate-oval to nearly orbicular, with seven to nine longitudinal nerves. Pedicel not bibracteolate. Sepals obtuse, scarcely longer than the rounded capsule. Styles distinct at apex.

8. *Ranapalus*.

Stem glabrous. Leaves spatulate-oblong, with one evident longitudinal nerve. Pedicel bibracteolate. Sepals acute or acutish, much exceeding the acute capsule. Styles united to apex, and stigmas short, semi-capitate.

9. *Bramia*.

Corolla pubescent within over bases of all lobes, blue throughout; posterior lobes united to apex. A circle of bristles surrounding the base of the ovary. Outer sepal slightly cordate, evidently exceeding the linear-attenuate innermost. Capsule less than one-half as broad as long. Leaves clasping, broadest proximally, crenate. Pedicels bibracteolate, spreading in fruit. Stem pubescent. Plant lemon-scented.

10. *Hydrotrida*.

Stamens two, the antero-laterals lost. Corolla 3 mm. long, white. Outer sepal deeply cordate and conspicuously reticulate. Stem finely pubescent. Pedicels not bibracteolate.

11. *Herpestis*.

Leaves dimorphic; several lanceolate ones borne on the abbreviated basal portion of the stems, and a pair of oval ones at the apex of the slender distal portion. Capsule wider than long, deeply notched, with rounded flattened lobes, only dehiscing loculicidally.

12. *Amphianthus*.

Seeds with fine transverse lines. Corolla with two raised ridges (each formed by the adherence of the filament) to the antero-lateral sinuses, and which project as knob-like processes beyond this point (the free portion of the filament appearing as a lateral outgrowth of the adherent portion). Posterior lobes of the corolla less than two-thirds the length of the anterior.

Corolla violet-blue, 6-11 mm. long, the posterior lobes  $\frac{1}{3}$ - $\frac{2}{3}$  length of the anterior. Postero-lateral stamens perfect, antero-lateral filaments without anthers. Style with an enlarged callose base. Sepals five, united at base. Capsule two-celled, oval in outline, 2-5 mm. long. Ascending or repent.

13. *Ilysanthes*.

Corolla pale-lavender or white, 1.5-2 mm. long. Postero-lateral stamens lost, antero-lateral filaments with anthers. Style filamentous to base. Sepals four, the posterior lost. Capsule one-celled at maturity (by loss of septum and shortening of the placentæ), globose, 1 mm. long. Repent.

Sepals united only at base. Corolla with posterior lobes evident, united one-half length of anterior. Styles distinct less than one-fourth length. Leaves orbicular. 14. *Globifera*.

Sepals united  $\frac{1}{2}$ — $\frac{2}{3}$  length, split nearly to base on the anterior side. Corolla with the posterior lobes lost, the tube split nearly to base on posterior side. Styles distinct  $\frac{1}{2}$ — $\frac{2}{3}$  length. Leaves elliptic-obovate. 15. *Hemianthus*.

Leaves bipinnatifid. Seeds pale greenish-yellow, ridged, with faint transverse lines. Pedicel not bibracteolate. Corolla lavender. Erect. 16. *Leucospora*.

### III. VERBASCEÆ

### IV. CHELONEÆ.

Seeds angled or winged, maturing many to each cell. Corolla-lobes uniformly colored, shorter than the tube which is not conspicuously pouched at base posteriorly. Posterior filament a conspicuous process. Sepals nearly or quite distinct. Plants stiff, 4–20 dm. tall.

Corolla white or pink-red, pubescent or glabrous within, its anterior lobes projecting. Sepals distinct. Sterile filament slender, filiform, white.

Corolla membranous, somewhat pubescent or glabrous within over base of anterior lobes. Sterile filament as long as the others, pubescent on its posterior face. Anther-sacs distinct, glabrous or barbate with short hairs. Sepals lanceolate to ovate, acute to acuminate. Seeds wingless. Inflorescence compound, a raceme of cymosely branching lax flower-clusters.

#### 18. *Penstemon*.

Corolla semi-fleshy, densely pubescent within over base of anterior lobes. Sterile filament much shorter than the others, glabrous. Anther-sacs becoming confluent, densely lanate. Sepals ovate-orbicular, rounded. Seeds winged. Inflorescence simple, a spike-like raceme of single flowers on short several-bracted pedicels.

#### 19. *Chelone*.

Corolla red-brown, glabrous within, its antero-lateral lobes vertically projecting, the anterior lobe deflexed. Sepals obviously united at base. Sterile filament shorter than wide, two-lobed, red-brown. Inflorescence compound.

#### 20. *Scrophularia*.

Seeds rounded, smooth, maturing one to each cell. Anterior corolla-lobes blue, posterior white, all longer than the tube which is strongly pouched at base posteriorly. Posterior filament a crescentic scarcely raised process. Sepals united over one-third length, enclosing over half the capsule. Plant lax, 1–3 dm. tall.

### V. RUSSELIEÆ.

#### 21. *Collinsia*.

#### 22. *Russelia*.

## VI. ANGELONIEÆ.

23. *Angelonia*.

## VII. ANTIRRHINEÆ.

Plants glabrous. Flowering stems erect. Leaves linear, only the uppermost small ones with axillary flowers. Pedicels not over 10 mm. long.

24. *Linaria*.

Plants hirsute. Flowering stems prostrate. Leaves ovate to orbicular, nearly all with axillary flowers. Pedicels over 10 mm. long.

25. *Kickxia*.

## VIII. VERONICEÆ.

Leaves whorled. Corolla white, its lobes shorter than the tube. Capsule acute, longer than broad, not flattened. Plant 10-20 dm. tall.

26. *Veronicastrum*.

Leaves opposite or alternate. Corolla blue or white, its lobes longer than the tube. Capsule acute to deeply notched, broader than long, flattened. Plants lower.

27. *Veronica*.

## IX. BUCHNEREÆ.

Corolla not blue, with open orifice. Stamens all with anthers two-celled, lanate. Filaments and style nearly as long as or longer than the tube of the corolla. Capsule exserted from the calyx-tube. Pedicels not bracted.

Corolla tubular, orange, with thickened base, fleshy, semi-persistent, shriveling and blackening before falling. Filaments equal, long-exserted, pubescent with beaded hairs. Anther-sacs closely parallel, 6-7 mm. long. Pedicels deflexed in fruit.

28. *Macranthera*.

Corolla with inflated throat and spreading lobes, yellow or pink, membranous, soon falling. Filaments not long-exserted, pubescence not beaded. Anther-sacs less than 5 mm. long. Pedicels erect or permanently spreading.

Anther-sacs glabrous or with a few bristle-like hairs at apex. Stigma short, punctiform or capitate. Filaments dilated-flattened and pubescent. Corolla yellow.

Corolla densely pubescent within on all sides, its lobes all distinct and slightly shorter than the tube. Filaments clearly didynamous, dilated and pubescent throughout. Anther-sacs each opening by a slit its entire length. Style short, thick, more or less bilobed, persistent and reflexed on the capsule. Pedicels 1-2 mm. long. Plant stout, 15-20 dm. tall, the leaves 10-30 cm. long.

29. *Dasistoma*.

Corolla slightly pubescent within (in a ring about the base of the filaments and below posterior sinus), its lobes longer than the tube, the two posterior united nearly one-half their length. Filaments nearly equal, dilated and pubescent at base. Anther-sacs each opening by a slit one-sixth to one-fourth its length. Style long, slender, entire, deciduous,

straight. Pedicels 4-10 mm. long. Plants slender, 2-10 dm. tall, the leaves 1-3 cm. long.

30. *Afzelia*.

Anther-sacs lanate on the valvular surface. Stigma linear, consisting of a line down each side of the linguiform style-apex. Filaments slender, not dilated, more or less lanate.

Corolla yellow. Capsule acute to acuminate. Leaves lanceolate to ovate, entire to bipinnatifid, petioled. Stem stout, over 4 dm. tall.

31. *Aureolaria*.

Corolla pink, with red spots within on the anterior side. Capsule rounded, with a mucro. Leaves filiform to lanceolate, entire or auriculate-lobed at base, sessile. Stem usually slender.

Stem ascending-scabrous to glabrous. Leaves linear to filiform, entire. Pedicels over 1 mm. long. Calyx-lobes linear to subulate, slightly longer to much shorter than the tube. Anther-sacs of both pairs of stamens uniform. Capsule globose to globose-ovoid, 3-7 mm. long. Seeds closely reticulate.

32. *Agalinis*.

Stem retrorse-hispid. Leaves lanceolate, usually auriculate-lobed at base. Pedicels less than 1 mm. long. Calyx-lobes ovate, longer than the tube. Anther-sacs of posterior stamens shorter. Capsule broadly ovate in outline, 10-13 mm. long. Seeds reticulate with raised ridges.

33. *Otophylla*.

Corolla purple-blue or white, salverform, the tube very narrow and densely pilose within, the lobes widely spreading. Stamens each with but one anther-sac developed. Filaments and style less than one-half length of corolla-tube. Capsule mostly or quite enclosed within calyx-tube. Pedicels bibracteolate.

34. *Buchnera*.

X. RHINANTHÆ.

Posterior sepal shorter than the others. Pedicels bibracteolate at apex. Capsule turgid, septicidal, only tardily slightly loculicidally dehiscent. Seeds linear, flat, 2 mm. long.

35. *Schwalbea*.

Posterior sepal wanting. Pedicels not bracted. Capsule flattened, loculicidal, splitting through septum. Seeds turgid. Corolla with posterior lobes projecting, not hooded at apex, the anterior lobes very short, thickened, deep-green. Capsule cylindric, equally two-celled, in dehiscence splitting on both posterior and anterior sides. Seeds many, reticulate. Bracts foliaceous, distally scarlet.

36. *Castilleja*.

Corolla with posterior lobes arched, hooded at apex, the anterior lobes membranous, flat, colored. Capsule ensi-

form, unequally two-celled, splitting only on the posterior side. Seeds few, not reticulate. Bracts not colored.

Corolla yellow or pink throughout, the anterior lip not raised into a palate. Anthers glabrous. Seeds maturing more than four to a capsule. Sepals of each side united nearly or quite to apex. Leaves bipinnatifid-lobed.

37. *Pedicularis*.

Corolla white, the anterior lip raised into a yellow densely pubescent palate. Anthers pubescent. Seeds maturing two to four to a capsule. Sepals united at base only, the two postero-laterals longer. Leaves lanceolate, entire or setaceous-toothed near base.

38. *Melampyrum*.

1. **PAULOWNIA** Siebold and Zuccarini.

*Paulownia* Sieb. and Zucc., Fl. Jap. 1: 25. pl. 10. 1835. Type species, *P. imperialis* S. & Z., of Japan.

1. *Paulownia tomentosa* (Thunb.) Baill.

Of Japan. Is occasionally found, along roads, railways, etc. A frequently cultivated tree.

2. **CAPRARIA** Linné.

*Capraria* L. Sp. Pl. 628. 1753.

Type species, *C. biflora* L.

1. *Capraria biflora* L.

*Capraria biflora* L., l. c. 628. 1753. "Habitat in Curassao." Specimens from Curaçao seen in Herb. New York Botanical Garden.

Sandy soil, mostly along the beach, somewhat in waste ground and on edges of hammocks inland, subtropical Florida. A widespread species of lowland Tropical America. Very variable; varies with us mainly in size and proportions of leaf, and in the length of the hairs on the stem and pedicels, such hairs in the plant considered to be typical are entirely wanting. The pubescent state may be called forma *hirta* Loes., in Bull. Herb. Boiss., ser. II, 3: 284. 1903. ("Habitat in Guatemala, in dept. Chiquimula in ruderalibus ad S. Juan Ermita—Sel[er] n. 3314." Isotype seen in herbarium New York Botanical Garden.)

Flowering and fruiting probably throughout the year, although all specimens seen were collected between November and June. Corolla white or violet-tinged and slightly spotted with violet within throat. Normally the five stamens are fertile, but any, and as many as four, may become rudimentary. Examination of fresh flowers shows that both in *Capraria* and *Scoparia* the posterior lobes of the corolla are external in the bud, thus confirming the



impression gained from distribution and the nature of the glands in the leaves of the latter, that these genera belong to the *Gratiroleae*.  
Pennell (Florida)—9559, 9598, 9610, 9633.

### 3. *SCOPARIA* Linné.

*Scoparia* L., Sp. Pl. 116. 1753.

Type species, *S. dulcis* L.

#### 1. *Scoparia dulcis* L.

*Scoparia dulcis* L., l. c. 116. 1753. "Habitat in Jamaica, Curassao Hort. Cliff. 320." ex L., Hort. Cliff. 320. 1737. "Crescit in Curassao & Jamaica." No specimens from Curaçao seen, but the plant here considered unquestionably occurs there.

*Gratiola micrantha* Nutt., Amer. Jour. Sci. 5: 287. 1822. "Collected in East Florida, during October and November, 1821, by A. Ware, Esq." Type, collected by Nathaniel A. Ware, seen in Herb. Academy of Natural Sciences of Philadelphia.

*Scoparia grandiflora* Nash, Bull. Torr. Bot. Club 23: 105. 1896. "Collected in the flatwoods at Tampa [Florida], where it was quite frequent. [G. V. Nash] No. 2417." Type seen in Herb. Columbia University at the New York Botanical Garden. I have collected this at Tampa, my number 9643. *Scoparia dulcis* varies considerably in size of corolla, but no other character correlates with this, nor do larger-flowered plants occur in an environment distinct ecologically or geographically. Wide gradation in corolla-size may be found within one colony.

Waste places, cultivated ground, especially in sandy soil, southern Georgia to southeastern Texas and southward; wholly within the Coastal Plain. A wide-spread weed of lowland Tropical America.

Flowering and fruiting in subtropical Florida throughout the year, northward flowering in summer (from about May to September), and soon ripening fruit. Corolla white, at times the lobes slightly pinkish.

Pennell (Florida)—9643, 9656, 9678, 9702. (Louisiana)—4254.

### 4. *MIMULUS* Linné.

*Mimulus* L., Sp. Pl. 634. 1753.

Type species, *M. ringens* L.

Leaf-blades ovate, petioled. Angles of stem slightly winged. Pedicels stout, in fruit 5–10 mm. long. Calyx-lobes setaceous-tipped, 1–2 mm. long. Corolla 35 mm. long. Seeds pale-yellow.

1. *M. alatus*.

Leaf-blades lanceolate, not petioled. Angles of stem not winged. Pedicels slender, in fruit 30–60 mm. long. Calyx-lobes lanceolate, 3–5 mm. long. Corolla 20–30 mm. long. Seeds brownish yellow.

Cauline leaves with the blades narrowed at the base, not clasping. Corolla 20–25 mm. long.

2. *M. minthodes*.

Cauline leaves with the blades broader and clasping at the base. Corolla 25–30 mm. long.

3. *M. ringens*.

1. *Mimulus alatus* Ait.

*Mimulus alatus* Ait., Hort. Kew. 2: 361. 1789. "Nat. of North America. Introd. 1783, by Mr. William Malcolm."

Wet woods and shaded river-bottoms, loam soil, throughout the area above the Fall line, but not extending into the higher Appalachians; and along river-bottoms in the Coastal Plain. Ranges from Connecticut to Ontario and Kansas, south to northern Florida (along the Apalachicola River), Mississippi and Oklahoma.

Flowering from late July to late August, probably ripening fruit in September and October. Corolla lavender pink, within throat essentially as in *M. ringens* but the spots are smaller and the coloring fainter.

2. *Mimulus minthodes* Greene.

*Mimulus minthodes* Greene. Leaflets Bot. Obs. & Crit. 2: 1. 1909. "The type specimens are in U. S. Herb. and were collected at Birmingham, Ala., Aug., 1888." Type seen in United States National Herbarium.

Meadows, northern Georgia and northern Alabama; Piedmont region.

Not seen growing. Possibly not distinct from *M. ringens*.

3. *Mimulus ringens* L.

*Mimulus ringens* L., Sp. Pl. 634. 1753. "Habitat in Virginia, Canada . . . Hort. ups. 176. t. 2." In the Hortus Upsalensis 176, pl. 1, 1748, Linné described and figured our plant.

Swales and along streams in woodland, in loam, through the area above the fall line, reaching at least to 4400 feet altitude in the southern Appalachians, mostly more common northward; apparently not descending into the Coastal Plain. Ranges from Nova Scotia to Minnesota, south to upper South Carolina, northern Florida<sup>1</sup> and Kansas.

Flowering from mid July to late August, fruiting in September and October. Corolla lavender, paler externally, within on anterior side two ridges which distally bear purple-red spots and proximally two yellow areas mottled with faint brownish patches.

5. *MECARDONIA* Ruiz and Pavon.

*Mecardonia* R. and P., Syst. Veg. Fl. Per. et Chil. 164. 1798.

Type species, *M. ovata* Ruiz & Pavon, of Peru.

Corolla white, its posterior lobes united  $\frac{1}{2}$ — $\frac{2}{3}$  their length. Outer sepals lanceolate, rarely more than twice width of inner. Leaf-blades prevailingly lanceolate, conspicuously cuneate at base. Erect or somewhat diffuse.

<sup>1</sup> Reported from Quincy, Florida, by A. W. Chapman in West. Jour. Med. & Surg. 3: 473. 1845.

Leaf-blades mostly oblanceolate, long-cuneate at base. Pedicels mostly over 15 mm. long. Corolla-lobes less widely spreading.

Main stem-leaves 3-4.5 cm. long. Outer sepals 6-8 mm. long. Corolla about 10 mm. long. Plant branched above, usually 3-4 dm. tall, erect or nearly so.

1. *M. acuminata*.

Main stem-leaves 1.3-2 cm. long. Outer sepals 5-6 mm. long. Corolla 7-8 mm. long. Plant much branched from the base, 1-2 dm. tall, diffusely spreading and ascending.

1a. *M. acuminata peninsularis*.

Leaf-blades ovate, more shortly cuneate at base, 1-1.7 cm. long. Pedicels mostly 8-12 mm. long. Corolla 7-8 mm. long, its lobes relatively widely spreading. Plant apparently laxly ascending.

1b. *M. acuminata brevifolia*.

Corolla yellow, its posterior lobes united nearly to apex. Outer sepals ovate, more than four times width of inner. Leaf-blades often ovate, more shortly cuneate at base. Procumbent or ascending.

Corolla lemon-yellow, 6 mm. long, glandular-puberulent within. Outer sepals broadly ovate. Pedicels 1-2 times the length of the ovate bracts.

2. *M. procumbens*.

Corolla deep lemon-yellow, 7-8 mm. long, short-pubescent within. Outer sepals ovate. Pedicels several times the length of the lanceolate-ovate bracts.

3. *M. tenuis*.

1. *Mecardonia acuminata* (Walt.) Small.

*Gratiola acuminata* Walt., Fl. Carol. 61. 1788. Type not verified, but description evidently of plant here considered. Doubtless from lower South Carolina where this plant is common.

*Gerardia cuneifolia* Pursh, Fl. Amer. Sept. 422. 1814. "In Georgia. Bartram. v. s. in Herb. Banks." Type not verified. Description appears to be of our plant, but the statement is made that the leaves are alternate above while in *acuminata* they are opposite throughout.

*Malourea nigrescens* Benth., Comp. Bot. Mag. 1: 173. 1836. "(*Gratiola acuminata* Ell., non Pursh.)" ex Ell., Sketch Bot. S. C. & Ga. 1: 15. 1816. "Grows in ditches and wet places, extensively diffused." Elliott interpreted correctly the species of Walter, but Pursh had confused with this *Gratiola virginiana* L.

*Mecardonia acuminata* (Walt.) Small, Fl. S. E. Un. St. 1065, 1337. 1903.

Moist sandy loam, or heavier loam soil, usually near streams, in pineland or deciduous woodland, frequent or common in most portions of the Coastal Plain (although absent from such an area as the Altamaha Grit of southern Georgia), extending to Cape Canaveral in southern Florida although through the Everglade Keys mostly replaced by var. *peninsularis*; and also reaching the mountain valleys of western North Carolina and northern Georgia. Ranges from Maryland to Florida and eastern Texas, extending inland to western Kentucky, southern Missouri and eastern Oklahoma.

Flowering from May to September, and soon ripening fruit. Corolla white, within with longitudinal pink veins on the posterior side.

Pennell (Georgia)—4088. (Florida)—9658. (Louisiana)—4283.

**1a. *Mecardonia acuminata peninsularis* Pennell, var. nov.**

Plants much branched from the base, diffusely spreading and ascending. Main stem-leaves oblanceolate, long-cuneate at base, 1.3–2 cm. long. Outer sepals 5–6 mm. long. Corolla 7–8 mm. long.

Type, in hammocks and pine-lands, Black Point, below Cutler, Florida, collected in fruit and late flower, November 13, 1903, J. K. Small & J. J. Carter 824, in Herb. New York Botanical Garden; isotype in Herb. Academy of Natural Sciences of Philadelphia.

Moist places, pine-land, hammocks and everglades, southern Florida.

Pennell (Florida)—9542.

**1b. *Mecardonia acuminata brevifolia* Pennell, var. nov.**

Plants apparently laxly ascending, slightly branched, 1–4 dm. tall. Main stem-leaves ovate, cuneate at base, 1–1.7 cm. long. Outer sepals 5–6 mm. long. Corolla 7–8 mm. long.

Type, Gulfport, Mississippi, collected in flower September 8, 1900, F. E. Lloyd & S. M. Tracy 94; in Herb. New York Botanical Garden.

Moist places in longleaf pine-land, southern Georgia and northern Florida to southern Texas.

**2. *Mecardonia procumbens* (Mill.) Small.**

*Erinus procumbens* Mill., Gard. Dict. ed. VIII. n. 6. 1768. " . . . .  
Houst. MSS." Type not known to exist, but description appears to be of the plant here considered. Houston collected in tropical America.

*Mecardonia procumbens* (Mill.) Small, Fl. S. E. Un. St. 1065, 1338. 1903.

Moist soil, loam or sand, meadows and edges of hammocks, sub-tropical Florida.<sup>4</sup> A wide-spread weed of lowland Tropical America, perhaps introduced into our flora.

Flowering and fruiting probably throughout the year. Corolla externally greenish-yellow, within on the lobes lemon-yellow, and with more or less evident longitudinal dark veins on the posterior side.

Pennell (Florida)—9549.

<sup>4</sup>Reported as "*Monniera chamaedryoides peduncularis*" by Mohr, Contrib. Nat. Herb. 6: 721. 1901, as occurring in Alabama from "Upper Division Coast Pine belt to Coast Plain." Surely confused with a form of *Mecardonia acuminata*.

3. *Mecardonia tenuis* Small.

*Mecardonia tenuis* Small, Fl. S. E. Un. St. 1065, 1338. 1903. "Type, Key West, Fla., Blodgett, in Herb. C. U." Type seen in Herb. Columbia University at the New York Botanical Garden.

Light loam over limestone, hammock and thickets, Key West, Florida Keys, Subtropical Florida. Endemic, but so close to *M. procumbens* and to *M. peduncularis* (Benth.) Small of Texas that the actual relationship of these species should be more fully investigated in the field.

Pennell (Florida)—9555, 9599.

6. *GRATIOLA* Linné.

*Gratiola* L., Sp. Pl. 17. 1753.

Type species, *G. officinalis* L., of Europe.

Corolla slightly exceeding calyx, externally glabrous. Capsule nearly pyramidal, acuminate. Pedicels very short.

Plant pubescent with several-celled hairs. Leaves 1-2 cm. long; bracts usually much exceeding the flowers.

1. *G. pilosa*.

Plant glabrous. Leaves .8-1.2 cm. long; bracts not exceeding the flowers.

1a. *G. pilosa epilis*.

Corolla more than twice as long as the calyx, externally more or less puberulent. Capsule broader, acute to rounded. Pedicels longer. Stem glabrous or puberulent with one-celled hairs, these frequently gland-bearing.

Pedicels exceeding 10 mm. in length. Corolla within throat on posterior side densely pubescent with knobbed hairs. Capsule ovate in outline, 1-5 mm. long, equaled or exceeded by the sepals. Seeds .3-.5 mm. long, semi-globose to oblong.

Capsule 1-3 mm. long, much exceeded by the sepals. Stem-leaves clasping by a broad base, usually at least the upper with resinous dots. Roots perennial, slender. Stoloni-ferous.

Corolla golden-yellow throughout. Capsule 3 mm. long. Seeds brown. Leaves with blackish glandular dots.

2. *G. georgiana*.

Corolla with throat dull-yellow, the lobes white. Capsule 1-2 mm. long. Seeds paler. Leaves with brown glandular dots, these usually more sparsely distributed.

Leaf-blades linear-lanceolate to lanceolate, usually with a few coarse serratures. Sepals linear to linear-subulate. Capsule 1-2 mm. long.

3. *G. ramosa*.

Leaf-blades ovate, with many usually finer serratures. Sepals lanceolate to oblong-lanceolate. Capsule 2 mm. long.

4. *G. viscidula*.

Capsule 4-5 mm. long, about equaled by the sepals. Stem-leaves narrowed to a sessile or slightly clasping base, not

- resinous-dotted. Roots apparently annual, the main root thick, and giving off numerous fibers. Not stoloniferous. Corolla of earlier flowers 8-12 mm. long, not lined within, pubescent below anterior lobes with unknobbed hairs. Leaves prevailing lanceolate. 5. *G. neglecta*.  
 Corolla of earlier flowers 15-20 mm. long, purple-lined within, pubescent below anterior lobes with knobbed hairs. Leaves prevailing ovate. Pedicels more slender and usually longer. 6. *G. floridana*.  
 Pedicels less than 10 mm. long. Corolla within throat on posterior side pubescent with unknobbed hairs. Capsule globose, 5-6 mm. long, slightly exceeding the sepals. Seeds .7 mm. long, linear. Leaves and root as in *neglecta*. 7. *G. virginiana*.

1. *Gratiola pilosa* Michx.

*Gratiola pilosa* Michx., Fl. Bor. Amer. 1: 7. 1803. "Hab. in Carolinae inferioris uliginosis [A. Michaux]." Description sufficiently distinctive.

Moist or rather dry sandy pineland, common nearly throughout the Coastal Plain, south to central Florida; occasional inland, reaching the mountain-valleys of North Carolina and northern Alabama. Ranges from New Jersey to Florida, central Arkansas and eastern Texas.

Flowering from late May to September, and soon ripening fruit. Corolla white, throat distally with faint bluish-purple lines on all petals.

Pennell (Georgia)—10172. (Florida)—9671, 9682, 9709. (Alabama)—9721.

1a. *Gratiola pilosa epilix* Pennell, var. nov.

Plant throughout glabrous, or the sepals rarely with a few hairs. Leaves shorter, less evidently serrate. Corolla 7-9 mm. long. Calyx-lobes 4.5 mm. long, scarcely exceeding the capsule. Capsule browner than in the species.

Type, Myers, Lee Co., Florida, collected in flower and fruit July-August, 1900, A. S. Hitchcock 258, in United States National Herbarium; isotype in Herb. New York Botanical Garden.

Around ponds, southern Florida. Only the above specimens seen.

2. *Gratiola georgiana* Pennell, sp. nov.

Stem fleshy, glabrous, repent, ascending, 2-4 dm. long. Leaf-blades lanceolate to lanceolate-ovate, 1.5-2.5 cm. long, serrate to nearly entire, acute or acutish. Pedicels 7-15 mm. long. Calyx-lobes linear or nearly so, 4-8 mm. long. Corolla 8-12 mm. long, bright yellow. Capsule not seen.

Type, Augusta, Georgia, collected in flower by Dr. William Baldwin; in Herb. Academy of Natural Sciences of Philadelphia.

Wet pine-barrens, North Carolina<sup>a</sup> to Florida and Alabama; also in southern Delaware. Not seen growing.

This has been confused with the northern *Gratiola aurea* Pursh, of which perhaps it should be counted a southern variety. They may be separated as follows:

Plant erect or repent-ascending, 1-3 dm. long. Leaf-blades linear to lanceolate, frequently denticulate distally. Pedicels 10-25 mm. long, usually equaling or exceeding the bracts.

*G. aurea.*

Plant repent and ascending, 2-4 dm. long. Leaf-blades lanceolate to lanceolate-ovate, usually more uniformly serrate. Pedicels 7-15 mm. long, shorter than the bracts.

*G. georgiana.*

Beside the collection of Baldwin, Rugel 99 (U, Y) from an unstated locality on Florida, and also collected very many years ago, is this species. The plant is also well described by Elliott, "Sketch Bot. S. C. & Ga.," 1: 13. 1816. It should be re-collected.

### 3. *Gratiola ramosa* Walt.

*Gratiola ramosa* Walt., Fl. Carol. 61. 1788. Type not verified, but descriptive of this plant common in lower South Carolina.

*Gratiola quadridentata* Michx., Fl. Bor. Amer. 1: 6. 1803. "Hab. in Carolina inferiore [A. Michaux]." Type not verified, but description sufficiently distinctive.

Moist or wet sandy pineland, edge of ponds, common in the Coastal Plain, South Carolina to southern Florida, west to southern Mississippi. Varies with frequently broader leaves inland, and with shorter fleshier leaves in southern Florida. In the spring erect, but later in the season the stems become lax, long and much branched.

Flowering from March to September, and soon ripening fruit. Corolla with tube dull-yellow, the lobes dull-white, the tube with longitudinal brown lines.

Pennell (Georgia)—9523. (Florida)—9657, 9669.

### 4. *Gratiola viscidula* Pennell.

*Gratiola viscosa* Schwein., Le Conte, Ann. Lyc. N. Y. 1: 106. 1824. "Inhabits Virginia, and the upper parts of North Carolina." The plant now considered, although the description appears inaccurate in stating that the capsule is as long as the sepals. Type, from Salem, North Carolina, seen in Herb. Academy of Natural Sciences of Philadelphia. Not *G. viscosa* Hornem., Enum. Pl. Hort. Hafn. 19. 1807.

*Gratiola viscidula* Pennell, Torreya 19: 145. 1919. New name for *G. viscosa* Schwein.

<sup>a</sup> Reported as "*Gratiola aurea* Muhl." in Hyam's "Flora of North Carolina," N. C. Coll. A. & M. Arts, Bull. 164: 327. 1891; and in Mohr, Contrib. Nat. Herb. 6: 720. 1901, as from the Coast Plain of southern Alabama.

Swales and along streams, above the fall-line, through the Piedmont, ascending to the valleys of the southern Appalachians. Delaware to northern Georgia and eastern Tennessee.

Flowering from late June to September, and soon ripening fruit. Not seen growing.

5. *Gratiola neglecta* Torr.

*Gratiola neglecta* Torr., Cat. Pl. N. Y. 89. 1819. "Within thirty miles of the City of New York." Type probably seen in herbarium of Columbia University at the New York Botanical Garden. For discussion see Torrey 19: 146. 1919.

Wet loam, usually in deciduous woodland, frequent through the Piedmont, both east and west of the Appalachians; apparently not in the Coastal Plain, nor ascending appreciably into the mountains. Ranges across the continent northward, south in the East to northern Georgia and northern Alabama.

Flowering from April to June, and soon ripening fruit. Corolla with tube greenish-yellow, the lobes white, at times pinkish-tinged.

Pennell (Georgia)—9509. (Alabama)—9760, 9769, 9784.

6. *Gratiola floridana* Nutt.

*Gratiola floridana* Nutt., Jour. Acad. Nat. Sci. Phila. 7: 103. 1834. "Hab. near Chipola, in West Florida [in Herb. Academy of Natural Sciences]." Type, labeled "*Gratiola \* grandiflora*," collected in 1830, seen in Herb. Academy of Natural Sciences of Philadelphia.

*Gratiola macrantha* Chapm., Fl. S. Un. St. ed. III. 311. 1897. "Cool springs near Quincy, Middle Florida." Distinguished from *G. floridana* by having the staminodia present and relatively conspicuous. In this species, as in *G. neglecta*, the size of the rudiments of the antero-lateral stamens is quite variable.

Muddy banks and in wet woods, loam soil, in river-bottoms in the Coastal Plain, southern Georgia, southern Alabama and northern Florida; apparently occurring inland to the base of the mountains of northeastern Georgia and northeastern Alabama.

Flowering in April and May, fruiting in May and June. Corolla white, or pinkish on the lobes, yellow over base of the posterior lobes, and marked with longitudinal fine purple lines.

Pennell (Florida)—9704.

7. *Gratiola virginiana* L.

*Gratiola virginiana* L., Sp. Pl. 17. 1753. "Habitat in Virginia." For discussion of the type of this see S. F. Blake in *Rhodora* 20: 65. 1918.

*Gratiola sphaerocarpa* Ell., Sketch Bot. S. C. and Ga. 1: 14. 1816. "Grows in ponds 4 miles from Charleston [South Carolina], on the neck." Description distinctive, made from plants which flowered in the autumn. Type seen in the Elliott Herbarium at the Charleston Museum.

*Gratiola megalocarpa* Ell., l. c. 16. 1816. "Grows in ditches and pools from Pennsylvania to Carolina. Pursh." Ex Pursh, Fl. Amer. Sept. 12. 1814. "In ditches and pools: Pennsylvania to Carolina . . . v. v." With a plant of his own, Pursh combined an account of Walter's *Gratiola acuminata*; his own plant would appear to have been the species now



considered, although any extant type should be examined. Specimens from Salem, North Carolina, collected by Schweinitz and labeled "*megaclocarpa*," seen in Herb. Academy of Natural Sciences of Philadelphia.  
*Gratiola carolinensis* Le Conte, Ann. Lyc. N. Y. 1: 105. 1824. "Inhabits in wet grounds from Carolina to Florida." Description sufficiently distinctive. Probable type, collected by Le Conte at "Shallowford," seen in Herb. Academy of Natural Sciences of Philadelphia.

Wet loam, in shade, usually along streams, common through the Piedmont, not ascending into the Appalachians; and through the Coastal Plain south to central Florida. Ranges from New Jersey to Florida and Texas, inland in the Mississippi Valley to Illinois and Missouri.

Flowering from March to May, fruiting May to June. Corolla white, within with longitudinal purple lines, more pronounced on posterior side.

Pennell (Georgia)—9506. (Florida)—9705, 9714. (Alabama)—9726.

#### 7. *SOPHRONANTHE* Benth.

*Sophronanthe* Benth.; Lindl., Nat. Syst. Bot., ed. II, 445. 1836.

Type species, *S. hispida* Benth.

##### 1. *Sophronanthe hispida* Benth.

*Sophronanthe hispida* Benth., l. c. 445. 1836. "The plant was gathered by Drummond at Apalachicola." Isotype, Drummond 20, seen in Herb. Columbia University at the New York Botanical Garden.

*Gratiola subulata* Baldwin; Benth., in DC. Prod. 10: 405. 1846. "In Florida ( . . . Baldwin! . . . )." Specimen collected by Baldwin, labeled "W. Florida, St. Marys river, south side," so probably an isotype, seen in Herb. Academy of Natural Sciences of Philadelphia.

Dry sandy pineland, Coastal Plain, southern Georgia to Louisiana, south through the Florida peninsula to Dade County.

Flowering from late April to September, and soon ripening fruit; in southern Florida flowering and fruiting throughout the year. Corolla with tube externally yellowish-white, on lobes and within white.

Pennell (Georgia)—9528. (Florida)—9660, 9676, 9689, 9700.

#### 8. *RANAPALUS* Kellogg.

*Ranapalus* Kellogg, Proc. Calif. Acad. 7: 113. 1877.

Type species, *R. eisenii* Kell., of California.

##### 1. *Ranapalus rotundifolius* (Michx.) Pennell, comb. nov.

*Monniera rotundifolia* Michx., Fl. Bor. Amer. 2: 22. 1803. "Hab. in regione Illinoensi [A. Michaux]." Type not verified, but description sufficiently distinctive.

Aquatic in shallow mud-bottomed open ponds, central and western Tennessee. Through the Mississippi Valley from Indiana and Tennessee to North Dakota, eastern Colorado and northern Texas.

Flowering from July to September, and soon ripening fruit. Corolla with throat yellow within, the lobes white.

9. **BRAMIA** Lamarck.

*Bramia* Lam., Encyc. Meth., Bot. 1: 459. 1785.

Type species, *B. indica* Lam., of India.

1. ***Bramia monnieri*** (L.) Pennell, comb. nov.

*Lysimachia monnieri* L., Cent. Pl. 2: 9. 1756. "Habitat in America meridionali. Hallman." D. Z. Hallman sent to Linné specimens from Spain, so it would appear that the type of this was probably transmitted through him from some source in Spanish America.

*Monniera cuneifolia* Michx., Fl. Bor. Amer. 2: 22. 1803. "Hab. in locis mari inundatis Carolinae inferioris [A. Michaux]." Description sufficiently distinctive. Type of the genus *Habershamia* Raf., Neogyn. 2. 1825.

*Bramia monniera* (L.) Drake, Fl. Polyn. Franc. 142. 1892.

Sandy beaches, especially where subject to inundation, common within tidewater, both where brackish and where fresh, growing also in pools in the sand dunes, in the coastal pine-land, and inland up the river-courses as far as Lake Okeechobee; on and near the coast, North Carolina to Florida and Texas. A widespread maritime plant of both the New World and Old World Tropics. Variable in size of its vegetative parts, and even of its flowers, plants everywhere smaller occurring especially in drier situations and around the pineland pools.

Flowering in southern Florida throughout the year, northward from April to November; soon ripening fruit. Corolla with tube yellowish within, elsewhere white, or frequently tinged with pink. Anthers dark-purple.

Pennell (Florida)—9534, 9537, 9665.

10. **HYDROTRIDA** Small.

*Hydrotrida* Small, Fl. Miami 165. 1913.

Type species, *Obolaria caroliniana* Walt.

1. ***Hydrotrida caroliniana*** (Walt.) Small.

*Obolaria caroliniana* Walt., Fl. Carol. 166. 1788. Type not verified, but description sufficiently distinctive. Doubtless from lower South Carolina, a district where the species now considered is frequent.

*Monniera amplexicaulis* Michx., Fl. Bor. Amer. 2: 22. 1803. "Hab. in fossis, stagnis Carolinae [A. Michaux]." Type not verified, but description sufficiently distinctive.

*Monniera crenulata* Small, Bull. Torr. Bot. Club 22: 46. 1895. "Found by Mr. A. H. Curtiss, growing in the bottom of ditches between Jacksonville and Trout Creek, Florida, on July 13, 1893." Type seen in Herb. Columbia University at the New York Botanical Garden. This represents but a robust, broad-leaved state of the species.

*Hydrotrida caroliniana* (Walt.) Small, Fl. Miami 165. 1913.

Aquatic in shallow water, sandy soil, edges of ponds and in small streams, in pineland in the Coastal Plain, North Carolina to Florida

and Louisiana, south through the Florida peninsula to the Everglades.

Flowering from May to September, and soon ripening fruit; in southern Florida flowering and fruiting throughout the year. Corolla uniformly sky blue.

In the herbarium of Columbia University is a memorandum description of this by Boykin. He proposed it as a new genus, but his name "Beyrichia" was preoccupied, and unfortunately no name was substituted and his suggestion has lain unheeded.

Pennell (Florida)—9675, 9683.

#### 11. *HERPESTIS* Gaertner, f.

*Herpestis* Gaertn. f., Fruct. et Sem. Pl. 3: 186. 1807.

Type species, *H. rotundifolia* Gaertn. f.

##### 1. *Herpestis rotundifolia* Gaertn. f.

*Herpestis rotundifolia* Gaertn. f., l. c. 186. pl. 214. 1807. "E America septentrionali a Dno Bosc, ex collectione Desfontaines." Bosc collected in Carolina, and his plant, as shown from the parts described, is certainly the species now considered. While Gaertner was doubtless influenced in his selection of a name by Michaux' *Monniera rotundifolia*, 1803, Bosc's plant is stated to be only perhaps this. Moreover Michaux' name is not connected with the phrase "*Herpestis rotundifolia*," so that we must consider this combination as here originating for the plant of Bosc. This has been confused with *Gratiola repens* Sw., a species of *Ranapalus*.

In shallow water, muddy shores, within the Coastal Plain, Maryland to Florida. Also in the West Indies. Very few collections are known, and in our area only the following stations have been noted: Wilmington, North Carolina; Ogeechee, Georgia; Jacksonville and Eustis, Florida. While doubtless often overlooked, the plant is certainly of scattered and rare occurrence.

Flowering at least from July to September, and soon ripening fruit. Not seen growing.

#### 12. *AMPHIANTHUS* Torrey.

*Amphianthus* Torr., Ann. Lyc. N. Y. 4: 82. 1837.

Type species, *A. pusillus* Torr.

##### 1. *Amphianthus pusillus* Torr.

*Amphianthus pusillus* Torr., l. c. 82. 1837. "Hab.—In small excavations on flat rocks, where the soil is wet during the flowering season; Newton County, Georgia . . . Dr. M. C. Leavenworth!" Type seen in Herb. Columbia University at the New York Botanical Garden.

"Growing in water in very shallow depressions in granite rock," Stone Mountain and nearby granite hills of Dekalb and Newton counties, central Georgia.

Flowering in April, fruiting in May. Not seen growing.

Apparently this plant only flourishes during wet seasons. On April 25, 1917, I searched most carefully for it on the summit and slopes of Stone Mountain (Canby's record of May 15, 1869, specifies "the summit"), but found no trace whatever. The season had been dry and there were no pools.

A remarkable plant with a unique dimorphic habit. It should be carefully studied living in order to assist in discovering its real relationship. Certainly aberrant in *Gratiolæ*, it may possibly belong to the *Veroniceæ*, as is suggested by the fruit. This was long ago the thought of Dr. Leavenworth as shown by his notes preserved in the herbarium of Columbia University.

### 13. *ILYSANTHES* Rafinesque.

*Ilysanthes* Raf., Ann. Nat. 13. 1820.

Type species, *I. riparia* Raf., of the banks of the Ohio.

Stem erect or ascending. Leaf-blades more or less elongate, the lower ones narrowed at the base.

Pedicels stout, shorter than the subtending bracts. Sepals usually as long as the capsule. 1. *I. dubia*.

Pedicels filiform, longer than the subtending bracts. Sepals shorter than the capsule.

Upper leaves or bracts but slightly smaller than the lower.

Pedicels erect or ascending (or in fruit rarely slightly reflexed). Leaves mainly cauline.

Stem-leaves partially clasping, all opposite, none of the leaves obviously punctate. Sepals decidedly shorter than the capsules. 2. *I. inaequalis*.

Stem-leaves sessile or narrowed at base, frequently in threes, the leaves all evidently glandular-punctate. Sepals scarcely shorter than the capsule. 3. *I. saxicola*.

Upper leaves or bracts reduced to scales. Pedicels conspicuously reflexed in fruit. Leaves mainly basal.

4. *I. refracta*.

Stem repent or prostrate throughout. Leaf-blades orbicular or ovate-orbicular, rounded at the base and closely sessile.

5. *I. grandiflora*.

#### 1. *Ilysanthes dubia* (L.) Barnhart.

*Gratiola dubia* L., Sp. Pl. 17. 1753. "Habitat in Virginiae aquis. . . . Gron. virg. 129." Type, Clayton 164, identified by Dr. B. L. Robinson in *Rhodora* 10: 67. 1908, as the species here considered.

*Capraria gratioloides* L., Syst. ed. X. 1117. 1759. Based upon *Gratiola dubia* L.

*Gratiola tetragona* Ell., Sketch Bot. S. C. and Ga. 1: 15. 1816. "Grows in ponds and ditches four miles from Charleston [South Carolina]." Type seen in the Elliott Herbarium at the Charleston Museum.

*Lindernia attenuata* Muhl.; Ell., l. c. 17. 1816. "Grows in wet places. Vall' Ombrosa, Ogechee, Georgia. Type seen in the Elliott Herbarium at the Charleston Museum. Isotype in Herb. Columbia University at the New York Botanical Garden.

*Ilysanthes dubia* (L.) Barnhart, Bull. Torr. Bot. Club 26: 376. 1899.

Swamps, and stream margins, especially in groves or woodland, loam soil, through the southern Appalachians and the Piedmont, both east and west of the mountains, apparently more frequent northward; in the Coastal Plain occasional or local, in heavier soils, along river-bottoms and along the coastal bays. Ranges from New Brunswick and Ontario south to northern Florida; also in the West Indies and South America. In the lower Piedmont and Coastal Plain forms transitional to *I. inaequalis* occur.

Flowering from May to September, and soon ripening fruit. Corolla pale lavender, deeper in color near margin of lobes, and within along the antero-lateral ridges with short yellow hairs.

Pennell (Florida)—9707. (Alabama)—9723.

2. *Ilysanthes inaequalis* (Walt.) Pennell.

*Gratiola inaequalis* Walt., Fl. Carol. 61. 1788. Type not verified, but is from lower South Carolina where the plant here considered is frequent. Walter's species was interpreted as this plant by Elliott, the most critical student of the Carolina flora.

*Gratiola anagallidea* Michx., Fl. Bor. Amer. 1: 6. 1803. "Hab. in humidis Carolinae [A. Michaux]." Type not verified.

*Lindernia dilatata* Muhl.; Ell., Sketch Bot. S. C. and Ga. 1: 16. 1816. "Grows in ditches, around ponds." Type seen in the Elliott Herbarium at the Charleston Museum. It is labeled "Vall Ombrosa," whereas that of *L. attenuata* bears no definite indication of locality. The first good characterization of this species.

*Gratiola dilatata* Muhl.; Spreng., Syst. 1: 39. 1825. "Carolin[a]." Surely based upon *Lindernia dilatata* Muhl., but this not cited.

*Ilysanthes inaequalis* (Walt.) Pennell, Torrey's 19: 149. 1919.

Swamps, loam and more usually in sandy soil, frequently in open situations, pineland pools and edges of hammocks, through the Coastal Plain, frequent or local; extending inland locally into the Piedmont. Ranges from Massachusetts to Florida and Texas; apparently also in Colorado, the Pacific Coast states, in Mexico, the West Indies, Central and South America. Intergrades with *Ilysanthes dubia*.

Flowering from March to September, and soon ripening fruit. Corolla as in *I. dubia*.

Pennell (Florida)—9649, 9673. (Alabama)—9768.

3. *Ilysanthes saxicola* (M. A. Curtis) Chapm.

*Lindernia saxicola* M. A. Curtis, Amer. Journ. Sci. 44: 83. 1843. "On rocks in the Hiwassee River [North Carolina] [M. A. Curtis]." Isotype seen in Herb. Columbia University at the New York Botanical Garden.

*Ilysanthes saxicola* (M. A. Curtis) Chapm., Fl. S. Un. St. 294. 1860.

On rocks in rapid mountain-streams, known only from the Hiwassee River in North Carolina, and from the headwaters of the Savannah River at Tallulah Falls, northern Georgia.

Flowering at least in August and September, and soon ripening fruit. Not seen growing.

4. *Ilysanthes refracta* (Ell.) Benth.

*Lindernia refracta* Ell., Sketch Bot. S. C. and Ga. 1: 579. 1821. "Grows around the margins of ponds in Barnwell district, South Carolina; in Burke County, and near Milledgeville, Georgia." Type, "Hab. in sphagnis, Barnwell Co., So. Car.," seen in Elliott Herbarium at the Charleston Museum.

*Tiltmannia monticola* Spreng., Syst. 2: 800. 1825. "Carolina bor. (*Lindernia monticola* Nutt.)." The name of Nuttall was a *nomen nudum*, and Nuttall (Gen. Am. 1: 9. 1818) says, perhaps due to a typographic slip, "from the hills of New Hampshire." But that the name *monticola* was in use before the date of Sprengel's publication is proven by the existence of old specimens labeled "*Lindernia monticola*," collected by Schweinitz probably in North Carolina. Such a specimen, in the herbarium of Columbia University at the New York Botanical Garden, is probably an isotype of *T. monticola*, and is *Ilysanthes refracta*.

*Ilysanthes refracta* (Ell.) Benth., in DC. Prod. 10: 419. 1846.

Moist sandy soil, shallow depressions in pineland, in the Coastal Plain from South Carolina to northern Florida and eastern Alabama; inland on the granite of central Georgia and eastern Alabama, and likewise in the Piedmont of central North Carolina, doubtless also on granite.

Flowering from March to September, and soon ripening fruit. Corolla externally violet-purple, paler on the anterior side, within paler, but with three violet-purple streaks below the posterior sinuses, a horizontal band of violet-purple on anterior side just within the mouth, and with darker blotches below the anterior sinuses.

Pennell (Georgia)—4053, 9510, 9522.

5. *Ilysanthes grandiflora* (Nutt.) Benth.

*Lindernia grandiflora* Nutt., Gen. Amer. 2: 43. 1818. "Hab. On the spongy margins of sandy springs and ponds in Georgia, (betwixt Savannah and Augusta in many places)." Type seen in Herb. Academy of Natural Sciences of Philadelphia.

*Ilysanthes grandiflora* (Nutt.) Benth. in DC. Prod. 10: 418. 1846.

Moist sandy soil, especially along streams, in longleaf pineland, and southward in the Everglades, southern Georgia to southern Florida.

Flowering from March to at least July, probably to September, and soon ripening fruit. Corolla externally violet-blue, paler on anterior side; posterior lobes externally pale purplish-blue, within very pale and with light-violet median line; anterior lobes white externally and within, excepting for two violet-blue blotches near the bases of the lobes.

Pennell (Florida)—9654, 9670, 9672.

14. **GLOBIFERA** J. F. Gmelin.

*Globifera* J. F. Gmel., Syst. 2: 32. 1791.

Type species, *Anonymos umbrosa* Walt.

1. **Globifera umbrosa** (Walt.) J. F. Gmel.

*Anonymos umbrosa* Walt., Fl. Carol. 63. 1788. Type, probably from lower South Carolina, identified by Dr. S. F. Blake, in *Rhodora* 17: 131. 1915, as the species here considered.

*Micranthemum orbiculatum* Michx., Fl. Bor. Amer. 1: 10. pl. 2. 1803. Type not verified, but description and plate evidently of species here considered. Type of genus *Micranthemum* Michx.

*Micranthemum emarginatum* Ell., Sketch Bot. S. C. and Ga. 1: 18. 1816. "Grows in ditches and wet places—Vall'Ombrosa, Great Ogeechee." Type seen in Elliott Herbarium at the Charleston Museum. Said to be "in the upper country, common," and characterized from the "very common" (and evidently lowland) *M. orbiculatum* by its more remote and larger leaves. *Globifera umbrosa* varies considerably in size of leaves, but the ample collections at hand show this to be ecologic, and not to distinguish plants of differing range.

Wet loam or in shallow water, in woodland, especially in river-bottoms, locally common throughout the Coastal Plain, especially near the ocean, North Carolina to central Florida and eastern Texas; rarely reported from above the fall-line. Also in eastern Mexico and the West Indies.

Flowering from May to October, and soon ripening fruit. Corolla uniformly dull-white. Anthers red-brown.

Pennell (Florida)—9706.

15. **HEMIANTHUS** Nuttall.

*Hemianthus* Nutt., Journ. Acad. Nat. Sci. Phila. 1: 119. pl. 6. 1817.

Type species, *H. micranthemoides* Nutt., of Pennsylvania.

1. **Hemianthus glomeratus** (Chapm.) Pennell, comb. nov.

*Micranthemum nuttallii glomeratum* Chapm., Fl. S. Un. St. ed. III. 313. 1897. "Rivers and wet banks, South Florida." Type not verified.

Sandy shores of lakes and rivers, known from Lake Okeechobee and along the Gulf coast from Tampa to the Caloosahatchee River, southern Florida.

Flowering and fruiting probably throughout the year, the specimens seen collected in May and November. Not seen growing.

This may be distinguished from the other species of the eastern United States, *Hemianthus micranthus* (Pursh) Pennell (*H. micranthemoides* Nutt.) of the Delaware and Chesapeake drainage by the following contrast:

Calyx-lobes obtuse or obtusish, less than one-fourth the length of the tube. Anterior lobe of the corolla nearly as long as the portion of the anterior lip below the base of the lateral lobes.

*H. micranthus*.

Calyx-lobes acute, one-third to one-half the length of the tube.  
Anterior lobe of the corolla about half as long as the portion  
of the anterior lip below the base of the lateral lobes.

*H. glomeratus.*

16. **LEUCOSPORA** Nuttall.

*Leucospora* Nutt., Journ. Acad. Nat. Sci. Phila. 7: 87. 1834.

Type species, *Capraria multifida* Michx.

1. **Leucospora multifida** (Michx.) Nutt.

*Capraria multifida* Michx., Fl. Bor. Amer. 2: 22. pl. 35. 1805. "Hab. in ripis arenosis fluminum amniculorumque, in Tennesse et Illinoensi regione." Type not verified, but description and plate certainly of species here considered.

*Leucospora multifida* (Michx.) Nutt., l. c. 87. 1834.

Sandy or loam banks of brooks or rivers, in open meadows or along shores, also in "Cedar Glades," Tennessee west of the Cumberland Mountains, to western Alabama and central Mississippi. Ranges from southwestern Ontario to Kansas, south to Alabama and Texas.

Flowering from June to October, and soon ripening fruit. Corolla pale-lavender, deeper on lobes, and lined with deeper lavender; tube within at base greenish-yellow, then yellow on the anterior side, and toward mouth with a purplish ring; white at base of the lavender anterior lobes. This plant has been placed in the very different tropical genus *Conobea* Aubl.

17. **VERBASCUM** Linné.

*Verbascum* L., Sp. Pl. 177. 1753.

Type species, *V. thapsus* L., of Europe.

Stem glabrous or with simple gland-tipped hairs above. Leaves glabrous. Pedicels 10-15 mm. long. Filaments all densely lanose with knobbed purple hairs. Capsule subglobose, glandular-puberulent. Seeds .8-.9 mm. long, dark-gray.

1. *V. blattaria*.

Stem pubescent with stellate glandless hairs. Leaves, at least beneath, pubescent. Pedicels less than 10 mm. long. Filaments: three posterior lanose, two anterior sparingly lanose to glabrous, with filiform yellow hairs. Capsules ovoid to oblong, stellate-pubescent. Seeds .4-.7 mm. long, brownish-gray.

Leaf-blades crenate, glabrate above, those of the stem sessile.

Pedicels usually several in an axil. Sepals about one-half length of capsule. Inflorescence not densely crowded.

Inflorescence a simple raceme, the pedicels 1-5 to an axil.

Capsule globose, 7-8 mm. long. Leaves green and slightly pubescent beneath.

2. *V. virgatum*.



Inflorescence a panicle of racemes, the pedicels 3-12 to an axil. Capsule oblong or oblong-ovoid, 4-5 mm. long. Leaves white and densely stellate-tomentose beneath.

3. *V. lychnitis*.

Leaf-blades entire or but obscurely crenate, densely pubescent above, those of the stem decurrent. Pedicels one to an axil. Sepals equaling the capsule. Inflorescence densely crowded.

4. *V. thapsus*.

1. *Verbascum blattaria* L.

Old fields and roadsides, throughout area north of central Florida. Naturalized from Eurasia.

2. *Verbascum virgatum* With.

Berkeley Co., South Carolina. Naturalized from Eurasia.

3. *Verbascum lychnitis* L.

Old fields and roadsides, occasional in North Carolina. Naturalized from Eurasia.

4. *Verbascum thapsus* L.

Old fields, roadsides and thickets, throughout area north of central Florida, usually common. Naturalized from Eurasia.

18. **PENSTEMON** [Mitchell] Schmidel.

*Penstemon* Schmidel, Icon. Pl. 2. 1762.

Type species, *Chelone pentstemon* L.

Leaf-blades dimorphic, those of the prostrate wintering stems entire or few-toothed, those of the erect flowering stems bipinnatifid with linear segments. Corolla pink-purple, its throat strongly inflated and but obscurely ridged anteriorly. Anther-sacs shallowly saccate. Sterile filament conspicuously exerted.

1. *P. dissectus*.

Leaf-blades uniform, entire or merely toothed. Corolla reddish-purple to white, its throat moderately to slightly inflated, obviously ridged anteriorly. Sterile filament included or slightly exerted.

Anther-sacs dehiscent by short proximal slits, the distal portion of each remaining pouch-like. Leaf-blades entire or essentially so. Branches of the inflorescence elongate. Corolla white, unlined, nearly glabrous within the throat.

2. *P. multiflorus*.

Anther-sacs dehiscent their entire length, so never pouch-like. Leaf-blades more or less serrate. Branches of the inflorescence less elongate. Corolla lanose within, nearly always with more or less conspicuous lines of deeper color within on the anterior side.

Corolla with throat relatively inflated, its mouth open, not closed by the anterior lip. Sterile filament slightly to moderately densely bearded. Plants taller.

Corolla white, rather strongly inflated. Anther-sacs usually barbate. Stem glabrous or nearly so.....3. *P. digitalis*.

Corolla more or less violet-purple, moderately inflated. Anther-sacs glabrous. Stem usually puberulent.

Corolla more open, its throat anteriorly shallowly two-ridged, and with broader less evident lines. Anther-sacs grayish. Sterile filament included, slightly bearded. Stem finely puberulent.

Calyx-lobes becoming 4-7 mm. long, one-half to two-thirds the length of the capsule. Corolla 20-25 (-28) mm. long, usually light violet-purple. Leaf-blades lanceolate, sparsely serrate. 4. *P. pentstemon*.

Calyx-lobes becoming 8-10 mm. long, equaling the capsule. Corolla 25-35 mm. long, usually deeper violet-purple. Leaf-blades broadly lanceolate, usually more serrate. 5. *P. calycosus*.

Corolla narrower, its throat within strongly two-ridged anteriorly, and (at least in *P. canescens*) with narrow sharply defined lines. Anther-sacs violet-purple. Sterile filament slightly exerted, moderately bearded. Stems more loosely puberulent.

Blades of the cauline leaves tapering from the broad base, more serrate, glabrous or nearly so. Corolla "bright pink-purple." Capsule broadly ovoid.

6. *P. smallii*.

Blades of the cauline leaves usually narrowed from above the narrower base, less serrate, more pubescent. Corolla faint violet-purple, conspicuously lined within throat. Capsule ovoid.

7. *P. canescens*.

Corolla with throat scarcely inflated, its mouth closed by the anterior lip, which rises as a convex arc. Sterile filament very densely bearded. Plants lower.

Corolla 20-25 mm. long, broader, red-purple, throat deeply lined within, white on anterior lobes within. Sterile filament bearded with golden-yellow hairs.

8. *P. australis*.

Corolla 25-30 mm. long, very narrow and slender, white throughout. Sterile filament bearded with lemon-yellow hairs.

9. *P. tenuiflorus*.

# 1. *Penstemon dissectus* Ell.

*Penstemon dissectus* Ell., Sketch Bot. S. C. and Ga. 2: 129. 1822. "This species was sent me from Louisville, Georgia, by Mr. Jackson." Type seen in the Elliott Herbarium at the Charleston Museum.

Light gravelly soil, rock-ledges, rock outcrops of Altamaha Grit, southern Georgia.

Flowering in April and May, fruiting in June. Corolla violet-purple, externally slightly redder, paler on anterior side, within

bluer on lobes, paler within throat and in a triangle at base of each lobe, the throat within with fine longitudinal violet-purple lines. Sterile filament with slightly yellowish hairs.

The peculiar dimorphism of the leaves of this species, as well as the occurrence of bipinnatifid leaf-blades, is unique in this genus.

Pennell (Georgia)—9527.

**2. *Penstemon multiflorus* Chapm.**

*Penstemon pubescens multiflorus* (Chapm.) Benth. in DC. Prod. 10: 327. 1846. "In Louisiana et Florida. *P. multiflorus* Chapm. mss." Specimen seen in Herb. Columbia University at the New York Botanical Garden, from "sandy pine woods, between Mariana & St. Andrew's Bay," collected by A. W. Chapman "Oct., 1838," and labeled "probably a distinct species," is probably an isotype.

*Penstemon multiflorus* Chapm.; Small, Fl. S. E. Un. St. 1061. 1903.

Sandy or gravelly soil, scrub-oak land or pine land, through peninsular Florida, and westward through Middle Florida to the West Florida Pine Hills, and in extreme southern Georgia.

Flowering from May to July, and soon ripening fruit, southward flowering and fruiting throughout the year. Corolla white, within slightly purple on proximal part of tube, and sometimes on the lobes.

Pennell (Florida)—9539, 9548, 9644.

**3. *Penstemon digitalis* Nutt.**

*Chelone digitalis* (Nutt.) Sweet, Brit. Fl. Gard. pl. 120. 1825. "*Penstemon Digitalis* Nutt. . . . Found by Mr. Nuttall in the Arkansas territory of North America. . . . The plant from which our drawing was taken was received last autumn from New York, by Mr. Anderson, of the Apothecaries' Garden at Chelsea, to whom it was sent by Mr. Hogg." A careful description and illustration, certainly of the plant now considered, the description being apparently more accurate than Nuttall's own in mentioning the pubescence of the anthers.

*Penstemon digitalis* Nutt., Trans. Amer. Phil. Soc. ser. II. 5: 181. 1837. "Hab. in wet woods and prairies [Arkansas Territory]; common. [T. Nuttall.]" Possible type, labeled "*Penstemon latifolium*, Arkansas, Nuttall," seen in Herb. Columbia University at the New York Botanical Garden. Described without reference to *Chelone digitalis*.

Fields and edges of woodland, loam, western Tennessee and near Birmingham, Alabama, probably elsewhere northward. Native in the southwestern Mississippi valley; extensively introduced into the northeastern United States, and probably an introduction into the southeastern flora.

Flowering in May and June, fruiting in August and September. Corolla white throughout, or within on the anterior side with more or less evident violet lines.

**4. *Penstemon pentstemon* (L.) Macm.**

*Chelone pentstemon* L., Sp. Pl. 612. 1753. "Habitat in Virginia." Type not verified, but must have been the species here considered, because in 1753 this was certainly the only essentially glabrous species of the Atlantic seaboard.

*Penstemon laevigatus* Ait., Hort. Kew. 2: 361. 1789. "*Chelone Penstemon* J. F. Miller ic. 4. . . . Nat. of North America. Cult. 1776, by John Fothergill, M. D." The description, and also the plate of Miller, clearly denote the species now considered.

*Bartramia pulchella* Salisb., Prod. Stirp. Chapel Allerton 99. 1796. New name for *Penstemon laevigatus* Ait. Type of genus *Bartramia* Salisb.

*Penstemon penstemon* (L.) Macm., Bull. Torr. Bot. Club 19: 15. 1892.

Meadows, river-banks and edges of forest, loam or clay, frequent or common through the Piedmont, both east and west of the mountains, and through the lower valleys of the southern Appalachians: descending along river-banks slightly into the Coastal Plain. Ranges from Virginia to northern Florida and Louisiana, and inland probably to Illinois; perhaps introduced westward.

Flowering from mid-May to mid-June, fruiting in July and August. Corolla externally violet-purplish, deepest on tube, on throat and lobes pale-purplish, nearly white on anterior side; within white, and within throat on anterior side with more or less evident violet lines. Sterile filament with yellow hairs.

Pennell (Georgia)—9787. (Alabama)—9746, 9756, 9780.

5. *Penstemon calycosus* Small.

*Penstemon calycosus* Small, Bull. Torr. Bot. Club 25: 470. 1898. "Nashville, Tennessee." This refers to a note in Bull. Torr. Bot. Club 21: 304. 1894, reporting the occurrence of "*Penstemon Smallii*" and stating: "Mr. Bicknell has lately discovered this . . . at Nashville, Tennessee. He remarks that it grows plentifully on the bluffs of the Cumberland River about that city." Type seen in Herb. Columbia University at the New York Botanical Garden.

Rocky places, limestone ledges, in forest, Tennessee Basin and lower slopes of the Cumberland Mountains, central and eastern Tennessee, and northern Alabama. Ranges northward to Indiana and Illinois.

Flowering from mid-May to mid-June, fruiting in July. Corolla externally violet-purple (redder than in *P. penstemon*), deeper posteriorly, fainter to white on anterior side; within nearly white within throat, on lobes faintly violet-purple, and with a few obscurely violet-purple lines within throat on anterior side. Sterile filament with yellowish hairs.

Pennell (Alabama)—9772.

6. *Penstemon smallii* Heller.

*Penstemon smallii* Heller, Bull. Torr. Bot. Club 21: 25. 1894. "Collected by the writer on Blowing Rock Mountain, Caldwell County, N[orth] C[arolina], July 21, 1890, at an elevation of 4000 feet. . . . Early in June, 1891, the locality was again visited in company with Mr. John K. Small." Type, Blowing Rock Mountain, Watauga Co., collected in flower June 10-20, Small & Heller 451, seen in Herb. Columbia University at the New York Botanical Garden. Isotype in Herb. Academy of Natural Sciences of Philadelphia.

Rocky lower mountain-slopes and on river-bluffs, in forest, Appalachians of North Carolina, eastern Tennessee and northernmost Georgia. Ranges northward into southwestern Virginia.

Flowering from late May to late June, fruiting in July. Not seen growing.

**7. *Penstemon canescens* (Britton) Britton.**

*Penstemon laevigatus canescens* Britton, Mem. Torr. Bot. Club 2: 30. 1890. "High, rocky banks of the Roanoke River [near Roanoke, Virginia, May, 1890, A. M. Vail and others]." Type, collected May 29, labeled by Dr. Britton who was of the party, seen in Herb. Columbia University at the New York Botanical Garden.

*Penstemon canescens* (Britton) Britton, l. c. 5:291. 1894.

Rocky loam, in open forest, lower mountain slopes, in the eastern Appalachians seen only from near the French Broad River in North Carolina; through at least the southern Cumberlands (abundant on Lookout Mountain), and in extreme northwestern Georgia (and doubtless northeastern Alabama).

Flowering in May and June, fruiting in July and August. Corolla externally faint violet-purple, within nearly white, and on the anterior side with eleven narrow sharply defined deep violet purple lines. Sterile filament with pale brownish yellow hairs.

Pennell (Georgia)—9785. (Tennessee)—5717, 9788.

**8. *Penstemon australis* Small.**

*Penstemon australis* Small, Fl. S. E. Un. St. 1060, 1337. 1903. "Type, Nash, Pl. Fla., 1822, in Herb. C. U." Type, Eustis, Lake County, Florida, collected in flower and fruit May 28-June 15, 1895, seen in Herb. Columbia University at the New York Botanical Garden.

Dry sandy soil, fields, scrub oak and pine land, through the Coastal Plain from North Carolina to central Florida and eastern Texas, mostly common; inland to the granite of central Georgia, and in upper South Carolina. Usually with broader leaves inland, while in the pine-barrens of the Coastal Plain the cauline may be fewer and usually much smaller so that the stem appears somewhat scapose.

Flowering in April and May, fruiting in June and July. Corolla externally reddish-purple, paler on anterior side; within red-purple on posterior lobes with on each a fine median line of deeper color, anterior lobes white, with deep red-purple streaks, three to each lateral lobe, and five, which anastomose distally, to the median lobe. Sterile filament with yellow hairs.

This and other southern species have been freely listed as "*Penstemon pubescens*" or "*P. hirsutus*," a northern plant, with lavender corollas, and not definitely known from our area.

Pennell (North Carolina)—4944. (Georgia)—4032, 9515, 9525. (Florida)—9680, 9694, 9708.

**9. *Penstemon tenuiflorus* Pennell.**

*Penstemon tenuiflorus* Pennell, *Addisonia* 4: 79, pl. 160. 1919. "The type specimen was collected in loam soil in open pineland, three miles southeast of Albany, Morgan County, Alabama, on May 27, 1917, my number 9753, and is preserved in the herbarum of the New York Botanical Garden."

Stem 3-6 dm. tall, whitish-puberulent. Blades of the cauline leaves 3-9 cm. long, obscurely serrulate, puberulent to pubescent. Panicle narrow, its branches glandular-pubescent. Calyx-lobes ovate, 3-5 mm. long. Corolla 25-30 mm. long, its throat narrowly arched and keeled posteriorly, flattened and strongly two-ridged within anteriorly; externally glandular-puberulent, within pubescent with yellow hairs over the projecting bases of the anterior lobes; white, faintly tinged externally and on margins of lobes with violet, not lined within throat. Posterior lobes united two-thirds their length, their free portions erect-recurved. Sterile filament distally densely bearded with short lemon-yellow hairs. Capsule not seen.

Open woodlands, in loam soil, western Tennessee and northern Alabama. Ranges north to Illinois and west to Oklahoma.

Pennell (Alabama)—9753.

**19. *CHELONE* Linné.**

*Chelone* L., *Sp. Pl.* 611. 1753.

Type species, *C. glabra* L.

Leaf-blades sessile and somewhat clasping.

1. *C. cuthbertii*.

Leaf-blades manifestly petioled.

Leaf-blades of a lanceolate type, narrowed to short petioles.

Corolla cream-white, white-lanose within the throat. Sepals obscurely or not ciliate.

2. *C. glabra*.

Leaf-blades of an ovate type, slightly cordate or narrowed into petioles 1.5-3 cm. long. Corolla rose-purple, yellow-lanose within the throat. Sepals evidently ciliate.

3. *C. lyonii*.

**1. *Chelone cuthbertii* Small.**

*Chelone cuthbertii* Small, *Fl. S. E. Un. St.* 1058, 1337. 1903. "Type, Highlands, N. C., Cuthbert, no. 283, in N. Y. B. G." Type, collected in flower August, 1897, in a wet meadow, at an altitude of 3800 feet, seen in Herb. New York Botanical Garden.

Wet meadows, western North Carolina. Little known, and the relation between this and *C. glabra* should be studied in the field.

Flowering in August. Not seen growing.

**2. *Chelone glabra* L.**

*Chelone glabra* L., *Sp. Pl.* 611. 1753. "Habitat in Virginia, Canada." Based upon a plant grown in the Clifford Garden in Holland. Description sufficiently distinctive.

Wet meadows and woodland swamps, through the southern Appalachians and Piedmont, common northward; descending into

the Coastal Plain in river-valleys, reaching Florida, probably near the Apalachicola River. Ranges from Newfoundland to Manitoba, south to northern Florida, and Kansas.

Flowering in late September and October, fruiting probably in October and November. Corolla cream-white, more or less pink-tinged within posterior lip, on anterior lobes, and laterally along anterior lip; occasionally entirely pink.

The forma *tomentosa* (Raf.) Pennell (in Torrey 19: 117. 1919), with leaves tomentose or pubescent beneath, is to be looked for in our area.

### 3. *Chelone lyonii* Pursh.

*Chelone lyonii* Pursh, Fl. Amer. Sept. 2: 737. 1814. "In Upper Carolina and Georgia. Lyon. . . . v. s. in Herb. Lambert."

*Chelone major* Sims, Bot. Mag. 44: pl. 1864. 1816. "Introduced by the late Mr. Lyons, from Carolina. . . . Communicated by Mr. Lambert, from Boyton, . . ." Obviously of the same origin as *C. lyonii* Pursh, and with a distinctive illustration.

*Chelone latifolia* Muhl.; Ell., Sketch Bot. S. C. and Ga. 2: 127. 1822. "This plant . . . was discovered . . . by Mr. Lyon along the base of the mountains of Carolina, but principally in Burke County, N. C." Description obviously of the species now considered. Described as having ovate leaf-blades, tapering at base, in contrast to the cordate blades of *C. lyonii* Pursh. This species shows complete gradation in leaf-form between these two states.

Moist mountain-woodland, eastern Appalachians, North Carolina and Tennessee, said to occur southward to northeastern Alabama.\*

Flowering from mid-July to mid-September, fruiting in September and October. Not seen growing.

## 20. *SCROPHULARIA* Linné.

*Scrophularia* L., Sp. Pl. 619. 1753.

Type species, *S. nodosa* L., of Europe.

### 1. *Scrophularia marilandica* L.

*Scrophularia marilandica* L., l. c. 619. 1753. "Habitat in Virginia."

Based upon a plant grown in the Upsala Garden, which from the description in the Hortus Upsalensis 177, 1748, would appear to have been the species now considered.

Open woodland, loam soil, Appalachians, and Piedmont both east and west of the mountains. Ranges from Massachusetts, southern Ontario and eastern Nebraska, south to Florida,<sup>7</sup> central Alabama and Arkansas.

\* Reported from Jackson Co., Alabama, by Mohr, Contrib. Nat. Herb. 6: 718. 1901.

<sup>7</sup> Reported from Quincy, Florida, by A. W. Chapman in West. Jour. Med. and Surg. 3: 473. 1845; and from the Marianna Red Lands of northern Florida by R. M. Harper, Fla. Geol. Surv. Rep. 6: 199. 1914.

Flowering in July and August, fruiting in August and September. Corolla externally pale-greenish, on posterior side brownish, within purple-brown on posterior side (on and below posterior lobes, and posterior half of antero-lateral lobes), anteriorly (elsewhere) pale-greenish. Sterile filament dark purple-brown.

The northern *Scrophularia leporella* Bickn., easily distinguished by its yellow sterile filament, its more cut leaves and its earlier flowering season (for fuller contrast see Torrey 19: 118), is to be looked for in upland North Carolina<sup>a</sup> and Tennessee.

The type of *Scrophularia serrulata* Small, Fl. S. E. Un. St. 1058, 1337. 1903, "Type Ga., Chapman, in Herb. C. U.," appears to be a specimen of the Palearctic *Scrophularia nodosa* L. The plant is from the Chapman herbarium but without indication of collector; certainly some confusing of data has occurred, or perhaps the specimen is from Georgia in the Caucasus.

#### 21. COLLINSIA Nuttall.

*Collinsia* Nutt., Journ. Acad. Nat. Sci. Phila. 1: 190. 1817.

Type species, *C. verna* Nutt.

##### 1. *Collinsia verna* Nutt.

*Collinsia verna* Nutt., l. c. 190. pl. 8. 1817. "On descending the Ohio . . . nearly to Galipolis, . . . I recognized it on the more open alluvions of the river, withered and nearly past affording seed. . . . From these seeds . . . I have been fortunate enough to obtain the plant from which the accompanying drawing was taken by . . . M. C. A. Le Sueur." Type seen in Herb. Academy of Natural Sciences of Philadelphia.

Moist woods, alluvial river-bottoms, in central or western Tennessee. Ranges from western New York to southern Minnesota. south to Tennessee and Missouri.

Flowering in late April and early May, and soon ripening fruit. Not seen growing.

#### 22. RUSSELLIA Jacquin.

*Russellia* Jacq., Enum. Pl. Carib. 25. 1760.

Type species, *R. sarmentosa* Jacq., of Cuba.

##### 1. *Russellia juncea* Zucc.

Occasional in pineland and hammock, Dade County, southern Florida. Escaped from gardens. Introduced from Mexico.

#### 23. ANGELONIA Humboldt & Bonpland

*Angelonia* H. & B., Pl. Aequin. 2: 92. pl. 108. 1809.

Type species, *A. salicariaefolia* H. & B., of Venezuela.

<sup>a</sup> Reported from western North Carolina by Hyams, N. C. Coll. A. & M. Arts, Bull. 164, 326. 1899.



1. *Angelonia angustifolia* Benth.

Occasional in pineland, Dade County, southern Florida. Escaped from gardens. Introduced from Mexico.

24. *LINARIA* Miller.

*Linaria* Mill., Gard. Dict. ed. IV. 1754.

Type species, *Antirrhinum linaria* L., of Europe.

Corolla, excluding spur, 4–12 mm. long, blue, posterior lip erect; anterior lip broadly spreading, but not forming a definite raised palate. Capsule 2–3.5 mm. long, equaling to exceeding the sepals. Seeds .3–.4 mm. long, cylindric, prismatic-angled, not winged. Stem less leafy, the younger stems spreading-prostrate from base. (Leptoplectron.)

Pedicels glandular-pubescent, longer than the corollas. Spur very short.

1. *L. floridana*.

Pedicels nearly glabrous, shorter than the corollas. Spur slender.

Corolla less than 8 mm. long, excluding the spur. Surface of seeds smooth to slightly tuberculate.

2. *L. canadensis*.

Corolla over 10 mm. long, excluding the spur. Surfaces and angles of seed densely tuberculate.

3. *L. texana*.

Corolla, excluding spur, 15–18 mm. long, yellow; posterior lip arched over anterior; anterior lip forming a conspicuous protruding orange palate; spur stout. Capsule 10 mm. long, much exceeding the sepals. Seeds 1.7 mm. long, flattened and circularly broadly winged. Stem densely leafy, always erect.

4. *L. linaria*.

1. *Linaria floridana* Chapm.

*Linaria floridana* Chapm., Fl. S. Un. St. 290. 1860. "Drifting sands near the coast, West Florida." Several specimens, collected by Dr. Chapman at Apalachicola, seen in Herb. New York Botanical Garden and Academy of Natural Sciences of Philadelphia.

Dry sandy soil, sand ridges along rivers and near the coast, southern Georgia to central Florida, westward near the Gulf Coast to southern Mississippi.

Flowering in March and April, and soon ripening fruit, the late flowering and fruiting plants persisting through May. Corolla light-blue, the palate paler.

Pennell (Florida)—9579, 9581.

2. *Linaria canadensis* (L.) Dum.-Cours.

*Antirrhinum canadense* L., Sp. Pl. 618. 1753. "Habitat in Virginia, Canada." Type probably from southern New Jersey, and certainly the species now considered. For discussion see Torrey 19: 151. 1919.

*Linaria canadensis* Dum.-Cours. Bot. Cult. 2: 96. 1802. "Lieu, Le Canada, la Virginie." Doubtless based upon *Antirrhinum canadense* L.

Open sandy soil, usually a weed, mostly common in the Atlantic Coastal Plain south to central Florida (intergrading somewhat with *L. texana* in Georgia and Florida); in the Piedmont on the

Granite of the Carolinas and central Georgia, and on other sandy soils, where probably introduced, inland to the southern Appalachians. Ranges northward to Massachusetts. Westward and inland at occasional stations where probably introduced.

Flowering from March to May, and soon ripening fruit. Corolla purplish-blue, the palate pale to white. Occasionally a pink-flowered form occurs.

Pennell (Georgia)—9502. (Florida)—9533, 9536, 9577, 9701.

3. *Linaria texana* Scheele.

*Linaria texana* Scheele, Linnaea 21: 761. 1848. "Zwischen Houston und Austin [Texas] häufig: Römer." Description sufficiently distinctive.

Open sand or sandy loam, frequently a weed, in the Coastal Plain from South Carolina to southern Mississippi, probably more common westward. Ranges widely through western North America, and into South America. Probably *Linaria canadensis* is a derivative of this.

Flowering from March to May and soon ripening fruit. Corolla pale-blue, reticulate-veined with slightly darker color, essentially as in *L. canadensis* but larger throughout.

Pennell (Georgia)—9512, 9521. (Alabama)—9724, 9727.

4. *Linaria linaria* (L.) Karst.

*Linaria vulgaris* Mill.

Loam or sandy soil, fields and waste ground, a weed; mostly above the Fall-line, probably common northward. Naturalized from Eurasia.

25. **KICKXIA** Dumortier.

*Kickxia* Dum., Fl. Belg. 35. 1827.

Type species, *Antirrhinum elatine* L., of Europe.

Leaf-blades rounded-cordate at base. Calyx-lobes ovate.

1. *K. spuria*.

Leaf-blades hastate. Calyx-lobes lanceolate.

2. *K. elatine*.

1. *Kickxia spuria* (L.) Dumort.

Waste places and roadsides, occasional eastward. Naturalized from Eurasia.

2. *Kickxia elatine* (L.) Dumort.

Waste places, roadsides and stone-walls, occasional eastward. Naturalized from Eurasia.

26. **VERONICASTRUM** Heister.

*Veronicastrum* Heist.; Fabr., Enum. Meth. Pl. Hort. Helmstad. 111. 1759.

Type species, *Veronica virginica* L.

1. *Veronicastrum virginicum* (L.) Farwell.

*Veronica virginica* L., Sp. Pl. 9. 1753. "Habitat in Virginia." Grown in the Clifford Garden. Certainly the species here considered.

*Veronicastrum album* Moench., Meth. 437. 1794. ". . . *Veronica virginica* L."

*Calistachya alba* Raf., Med. Repos. N. Y. Ind Hex. 5: 352. 1808. Based on *Veronica virginica* L. Type of *Calistachya* Raf., not *Callistachys* Vent., 1804.

*Eustachya alba* (Raf.) Raf., Cat. 14. 1824. *Eustachya* Raf., Amer. Mo. Mag. 4: 190. 1819, was a new name for *Calistachya* Raf. Preoccupied by *Eustachys* Desv., 1810.

*Leptandra alba* (Raf.) Raf., Med. Fl. 2: 21. 1830. "The true *V. virginica* of L. . . . The most common species being found all over the United States."

*Leptandra villosa* Raf., l. c. 21. 1830. "Mr. Schweinitz has found it in North Carolina." If the state with the leaves pubescent beneath be distinguished as a forma, this name should be used.

*Veronicastrum virginicum* (L.) Farwell, Drugg. Circ. 61: 231. 1917.

Varying, in number of leaves in whorl, in inflorescence of one or several racemes, and in leaves from lanceolate to nearly ovate, pubescent to nearly or quite glabrous beneath.

Sandy or loam soil, swales or moist meadows, hillside thickets, through the southern Appalachians and Piedmont, both east and west of the mountains, apparently scarce; rarely descending into the Coastal Plain. Ranges from Connecticut and Ontario and Minnesota, south to Mississippi and Texas.

Flowering in August, fruiting in September. Corolla white throughout, anthers brown.

27. **VERONICA** Linné.

*Veronica* L., Sp. Pl. 9. 1753.

Type species, *V. officinalis* L., of Europe.

Flowers solitary, axillary, frequently approximating so as to form a terminal raceme. Leaves alternate through the inflorescence.

Pedicels longer than the sepals, usually exceeding the bracts.

Sepals ovate. Capsule turgid. Seeds few, 1.3–3 mm. long, convex-arched, roughened. Leaves petioled (rarely the uppermost sessile), primarily palmately 5–7 nerved, the mid-vein usually with some radiating pinnate veins; mainly alternate, the lower sometime opposite.

Leaves broadly cordate, 3–5 lobed, the lobes rounded. Sepals broadly ovate, conspicuously ciliate. Capsule very turgid, scarcely notched at apex, only slightly 2-lobed. Seeds 2.5–3 mm. long, blackish. 1. *V. hederæfolia*.

Leaves ovate, serrate to dentate. Sepals more shortly ciliate. Capsule slightly flattened, deeply notched at apex, thus strongly two-lobed. Seeds 1.3–1.5 mm. long, brown.

Petals not exceeding the ovate sepals. Capsule-lobes rounded, the most distal point of each about midway between the style and the lateral margin.

2. *V. agrestis*.

Petals exceeding the narrowly ovate sepals. Capsule-lobes acutish, the most distal point of each near the lateral margin.

3. *V. persica*.

Pedicels shorter than sepals or bracts. Sepals linear to narrowly ovate. Capsule flattened. Seeds many, less than 1 mm. long, flat, smooth or nearly so. Leaves sessile (or the lower petioled), scarcely palmate, alternate only through the inflorescence.

Perennial. Repent, with ascending stems. Leaves oval or ovate, obscurely crenate. Inflorescence spike-like, restricted to the distal portion of the stem. Sepals ovate. Corolla white, with blue lines on posterior side. Capsule retuse or shallowly notched, glandular-pubescent.

4. *V. serpyllifolia*.

Annuals. Erect, much branched below. Most leaf-axils flower-bearing. Sepals lanceolate to linear. Capsule deeply notched.

Lower stem-leaves ovate, crenate-serrate, the lowermost frequently petioled. Corolla deep violet-blue. Capsule pubescent with slightly gland-tipped hairs. Plant pubescent with glandless hairs.

5. *V. arvensis*.

Lower stem-leaves oblanceolate, entire or distally remotely toothed, all sessile. Corolla whitish throughout. Capsule glabrous. Plant glabrous or with short gland-tipped hairs.

Plant glabrous.

6. *V. peregrina*.

Plant pubescent with gland-tipped hairs.

6a. *V. peregrina xalapensis*.

Flowers all in axillary small-bracted racemes. Leaves opposite throughout. Perennials.

Capsule glandular-pubescent, strongly two-lobed, longer than the sepals. Stems, pedicels, leaves and sepals pubescent. Leaves oval, crenate-serrate, narrowed to a petiolar base. Extensively repent, at apex ascending. Plant of dry soil.

7. *V. officinalis*.

Capsule glabrous, scarcely or not two-lobed, equaling the sepals. Plant glabrous or with scattered gland-tipped hairs. Leaves oblong-ovate to broadly lanceolate, obscurely crenate-serrate. Ascending or wholly erect. Aquatics.

Stem distally, rhachis and pedicels glabrous. Leaves oblong-ovate, all petioled, mostly emersed. Racemes usually 10-25 flowered. Plant emersed.

8. *V. americana*.

Stem distally, rachis and pedicels sparsely pubescent with glands, borne upon jointed stalks. Leaves lanceolate, clasping. Racemes usually 25-50 flowered. Plant nearly submersed.

9. *V. glandifera*.

# 1. *Veronica hederasfolia* L.

Waste places, mostly near cities, occasional. Naturalized from Eurasia.

**2. *Veronica agrestis* L.**

Waste places and fields, mostly near cities, occasional. Naturalized from Eurasia.

**3. *Veronica persica* Poir.**

Fields, roadsides and waste places, occasional or local. Naturalized from Eurasia.

Corolla with tube and base of lobes white, anterior lobes pale, lateral darker, posterior sky blue; lobes all with blue longitudinal veins.

**4. *Veronica serpyllifolia* L.**

Fields, thickets and waste places, common at least northward. Naturalized from Eurasia.

Corolla white or nearly so, on posterior side with blue lines.

**5. *Veronica arvensis* L.**

Fields, cultivated soil, and waste ground, common at least northward. Naturalized from Eurasia.

Corolla with all lobes deep sky-blue, whitish at base, veined with deeper sky-blue.

**6. *Veronica peregrina* L.**

*Veronica peregrina* L., Sp. Pl. 14. 1753. "Habitat in Europae hortis, arvisque." Described, as the specific name would suggest, from specimens of an introduced plant.

Fields and cultivated soil, especially where moist, common. Certainly American in origin, but now wholly weed-like.

Corolla uniformly dull-white.

Pennell (Florida)—9712. (Alabama)—9725, 9758.

**6a. *Veronica peregrina xalapensis* (H.B.K.) Pennell.**

*Veronica xalapensis* H. B. K., Nov. Gen. et Sp. 2: 389. 1817. "Crescit in Regno Mexicano prope Xalapa (alt. 630 hex. [ca. 1200 m.]), in nemoribus Liquidambaris Styrcifluæ."

*Veronica peregrina xalapensis* (H. B. K.) Pennell, Torrey 19: 167. 1919.

Occasional in cultivated soil. In the western half of the continent this glandular-pubescent variety quite replaces true *peregrina*. In the East it is only occasionally seen, and that probably as an introduction.

**7. *Veronica officinalis* L.**

Dry fields, open woods, and stony hillsides, common at least northward. Naturalized from Eurasia.

Corolla very pale-lavender, on posterior side with seven lavender-blue lines.

**8. *Veronica americana* Schwein.**

*Veronica americana* Schwein., Benth. in DC. Prod. 10: 468. 1846. "*Veronica americana* (Schweinitz! mss.). . . . In America boreali a

Canada et Carolina usque ad flum. Oregon et in ins. Sitcha . . . (v. s.). Specimen seen in Herb. Academy of Natural Sciences of Philadelphia, labeled "Bethl." [Bethlehem, Pennsylvania], collected by Schweinitz, may be of collection sent Bentham.

Springheads in woodland, and along streams, in the southern Appalachians of North Carolina and eastern Tennessee, in the Piedmont of South Carolina, likely occasional in this zone both east and west of the mountains. Ranges from Quebec to Alaska, south to South Carolina, New Mexico and California.

Flowering from June to August, and soon ripening fruit. Corolla pale-blue, distally with few rather faint deeper-blue lines.

**9. *Veronica glandifera* Pennell.**

*Veronica glandifera* Pennell, Torreyia 19: 170. 1919. "Type, vicinity of Suffolk, Nansemond County, Virginia, collected in flower and fruit May 27, 1893, N. L. Britton and J. K. Small; in herbarium Columbia University at the New York Botanical Garden."

Shallow flowing streams, mostly in calcareous soil, Appalachians of North Carolina and eastern Tennessee. Ranges from New Jersey to North Carolina, Minnesota and Kentucky.

Flowering in June and July, and soon ripening fruit. Corolla pale-blue, with few deeper-blue lines.

**28. *MACRANTHERA* Torrey.**

*Macranthera* Torr.; Benth., Comp. Bot. Mag. 1: 174. 1836.

Type species, *Conradia fuchsoides* Nutt.

**1. *Macranthera flammea* (Bartram) Pennell.**

*Gerardia flammea* Bartram, Trav. 410. 1791. "Stony gravelly heights [along Tensaw River near] Taensa" In Alabama. No type known to exist. Identified by Mohr in Contr. U. S. Nat. Herb. 6: 15. 1901.

*Conradia fuchsoides* Nutt., Journ. Acad. Nat. Sci. Phila. 7: 88. pl. 12. 1834. No locality given. Type, without data, seen in Herb. Academy of Natural Sciences of Philadelphia. Type of genus *Conradia* Nutt., not *Conradia* Mart., 1829.

*Macranthera lecontei* Torr., Ann. Lyc. Nat. Hist. N. Y. 4: 80. pl. 4. 1837. "In dry pine woods on the Alatamaha, in Liberty County, Georgia, Major Le Conte!" Type, without data, seen in Herb. Columbia University at the New York Botanical Garden.

*Dasystoma tubulosa* Bertol., Mem. Accad. Sci. Instit. Bologna 4: 75. pl. 4. 1853. "Ex Alabama, Dr. Gates." Probable isotypes seen in Herb. New York Botanical Garden, Herb. Academy of Natural Sciences of Philadelphia and Gray Herbarium.

*Macranthera flammea* (Bartram) Pennell, Bull. Torr. Bot. Club 40: 124. 1913.

Borders of wet sandy thickets, in the Coastal Plain, southern Georgia and northern Florida to eastern Louisiana.

Flowering from August to October, fruiting September and October. Corolla orange throughout.

Pennell (Florida)—4564, 4595, 4681. (Alabama)—4406, 4459, 4462, 4534, 4553, 4641.

**29. DASISTOMA Rafinesque.***Dasistoma* Raf., Journ. de Phys. 89: 99. 1819.Type species, *D. aurea* Raf., of Kentucky.**1. *Dasistoma macrophylla* (Nutt.) Raf.***Seymeria macrophylla* Nutt., Gen. N. Amer. Pl. 2: 49. 1818. "Hab. In shady alluvial soils of the banks of the Little Miami, near the town of Lebanon." In Ohio. Specimen in Kew Herbarium labeled "Ohio Nuttall misit Mart. 1824," may stand as the type; this seen.*Dasistoma macrophylla* (Nutt.) Raf., New Fl. Amer. 2: 67. 1837.*Brachygyna macrophylla* (Nutt.) Small, Fl. S. E. Un. St. 1073, 1338. 1903. Type of genus, *Brachygyna* Small.

Sandy to clay soil, mostly in rich woods, usually along streams, western North Carolina,<sup>9</sup> central Tennessee and northern Alabama. Ranges from Ohio to eastern Nebraska, south to northern Alabama and northeastern Texas.

Flowering in July and August, fruiting August and September.. Corolla yellow, externally tinged or marked with purple-red.

**30. APZELIA J. F. Gmelin.***Azelia* J. F. Gmel., Syst. 927. 1791.Type species, *Anonymos cassioides* Walt.

Stem closely pubescent, viscid. Leaf-segments lanceolate or broader. Calyx-lobes lanceolate. Corolla deep-yellow, externally pubescent, its lobes ovate, 3-3.5 mm. wide. Distal portion of filament and connective of anther lanose. Anther-sacs opening one-fifth to one-fourth length. Capsule ovate, 6-7 mm. long, densely tomentose with short brown more or less glandular hairs. Seeds winged. Plant low, 2-6 dm. tall, widely branched. Stem lanose to pubescent with reflexed-incurved to -appressed hairs. Pedicels 6-7 mm. long. Capsule densely glandular-tomentose, with hairs dark-jointed, some of them glandular-knobbed at tip. Seeds 1-1.2 mm. long.

**1. *A. pectinata*.**

Stem finely pubescent to puberulent in lines with ascending-incurved to -appressed hairs. Pedicels 7-10 mm. long. Capsule less tomentose to nearly glabrous, with hairs slightly dark-jointed, most or all of them glandular-knobbed at tip. Seeds 1.2-1.4 mm. long. 1a. *A. pectinata peninsularis*.

Stem sparingly pubescent, with ascending-incurved hairs, scarcely glandular. Leaf-segments filiform. Calyx-lobes linear. Corolla pale-yellow, externally glabrous, its lobes lanceolate, 1.5-2 mm. wide. Distal portion of filament and connective of anther glabrous. Anther-sacs opening one-sixth to one-fifth length. Capsule urceolate-acuminate, 4-4.5 mm. long, glabrous. Seeds not winged, .5-.7 mm. long. Plant 5-10 dm. tall, virgately branched.

**2. *A. cassioides*.**

<sup>9</sup> Reported from western North Carolina by Hyams, N. C. Coll. A. & M. Arts, Bull. 164: 327. 1899.

1. *Azalia pectinata* (Pursh) Kuntze.

*Seymeria pectinata* Pursh, Fl. Amer. Sept. 2: 737. 1814. "In South Carolina. Catesby. v. s. in Herb. Sherard." Type not seen, but description distinctive.

*Seymeria jacksoni* Ell., Sketch Bot. S. C. and Ga. 2: 123. 1824. "Sent to me from Louisville, Ga., by Mr. Jackson." Type seen in the Elliott Herbarium at the Charleston Museum.

*Seymeria heterophylla* Raf., New Fl. Amer. 2: 68. 1837. "Alabama and Georgia, my specimen from Le Conte." Type not known to exist.

*Azalia pectinata* (Pursh) Kuntze, Rev. Gen. 1: 457. 1891.

Dry sandy longleaf pineland, in the Coastal Plain from South Carolina<sup>10</sup> to Louisiana, south in the Florida peninsula to Brevard County; inland reported from the Pine Mountains of Meriwether County, Georgia,<sup>11</sup> and from the metamorphic region of northeastern Alabama.<sup>12</sup>

Flowering in August and September, fruiting September and October. Corolla deep golden-yellow, more or less marked with purple-red within throat and at the bases of the lobes.

Pennell (Georgia)—4732, 4760, 4780, 4845. (Florida)—4568, 4585, 4645, 4656, 4674, 4686, 4705, 4715, 4802. (Alabama)—4630.

1a. *Azalia pectinata peninsularis* Pennell, var. nov.

Stem 4-6 dm. tall, finely glandular-pubescent to -puberulent in lines with ascending incurved to -appressed hairs. Leaves glandular-pubescent to -puberulent, those of the stem 1-2 cm. long, 5-8 mm. wide. Pedicels in flower 5 mm. long, in fruit 7-10 mm. long. Calyx-lobes 4.5 mm. long. Corolla 8 mm. long, its tube 3-3.5 mm. long, its lobes 4.5 mm. long. Style 4-5 mm. long. Capsule minutely glandular-pubescent with hairs slightly dark-jointed, most or all with terminal knob-like glands. Seeds 1.2-1.4 mm. long.

Type, flat woods, Marco, Lee Co., Florida, collected in fruit July-August, 1900, A. S. Hitchcock 254, in United States National Herbarium.

Flat long-leaf pineland or hammocks, southern Florida.

Flowering June to August, probably flowering and fruiting throughout the year.

2. *Azalia cassioides* (Walt.) J. F. Gmel.

*Anonymos cassioides* Walt., Fl. Carol. 171. 1788. Presumably from lower South Carolina. Description sufficiently distinctive.

*Azalia cassioides* (Walt.) J. F. Gmel., Syst. 927. 1791.

*Gerardia azalia* Michx., Fl. Bor. Amer. 2: 20. 1803. New name for *Azalia cassioides* (Walt.) Gmel.

*Seymeria tenuifolia* Pursh, Fl. Amer. Sept. 737. 1814. New name for *Gerardia cassioides* (Walt.) Pers.

<sup>10</sup> Reported from lower North Carolina, collected by Croom [see M. A. Curtis, Bot. N. C. 39. 1867].

<sup>11</sup> Harper, Bull. Torr. Bot. Club 36: 587. 1909.

<sup>12</sup> Earle, Ala. Agric. Exp. Sta., Bull. 119: 104. 1902.



Moist or dry pineland, usually in sandy soil, in the Coastal Plain from North Carolina to Florida and Louisiana, in the Florida peninsula south to Manatee County; inland to the mountains of northern Georgia, northern Alabama and eastern Tennessee; also on the Bahamas.

Flowering from September to mid-October, and soon ripening fruit. Corolla pale-yellow, more or less marked with purple-red within throat and at the bases of the lobes.

Pennell (North Carolina)—4900, 4919. (South Carolina)—4866, 4872, 4878. (Georgia)—4725, 4743, 4762, 4809, 10173. (Florida)—4588, 4649, 4653, 4678, 4691, 4713, 4719, 9647. (Alabama)—4552, 4639. (Louisiana)—4217.

### 31. *AUREOLARIA* Rafinesque.

*Aureolaria* Raf., New Fl. Amer. 2: 58. 1837.

Type species, *Aureolaria villosa* Raf.

Annuals. Stem, leaves and calyx glandular. Leaves bipinnatifid, more or less pectinately cut. Calyx-lobes dentate to pectinate. Corolla externally glandular-pubescent, within pubescent below posterior sinus and over bases of posterior lobes; more or less marked or tinged with purple-red. Anther-sacs 2.5–4 mm. long. Capsule ellipsoid to broadly-ovoid in outline, glandular-puberulent to -pubescent. Seeds .8–1 mm. long, not winged.

(*Panctenis* Raf.)

Leaves less sharply cut, with mostly rounded teeth, puberulent to somewhat glandular-pubescent. Pedicels 10–28 mm. long. Calyx-tube turbinate, glandular-puberulent externally. Capsule narrowly to broadly ellipsoid, 9–15 mm. long, one-half to two-thirds enclosed in the calyx-tube. Seeds .8 mm. long. Stem closely pubescent above, not or slightly glandular. Leaves puberulent, not or slightly glandular. Calyx-lobes 8–10 mm. long. Capsule narrowly ellipsoid, 9–11 mm. long.

Leaves 3–6 cm. long, more strongly cut, incisions extending mostly about two-thirds distance to midrib, not or scarcely glandular. Pedicels permanently more or less glandular-pubescent. Calyx-tube 4–5 mm. long. Stem closely pubescent, not or scarcely glandular above.

#### 1. *A. pedicularia*.

Leaves 2–3.5 cm. long, less cut, incisions extending mostly about one-half distance to midrib, slightly glandular. Pedicels tending to become nearly glabrous. Calyx-tube 5–7 mm. long. Stem from nearly glabrous to slightly glandular.

#### 1a. *A. pedicularia carolinensis*.

Stem glandular-pubescent to hirsute above. Leaves glandular-puberulent to -pubescent. Calyx-lobes 10–16 mm. long,

relatively deeply lobed. Capsule broadly ellipsoid, 11-14 mm. long.

1b. *A. pedicularia austromontana*.

Leaves more sharply cut, with acute or acutish teeth, glandular-pubescent to -villose. Pedicels 4-20 mm. long. Calyx-tube hemispheric, glandular-hirsute to -lanose. Capsule broadly ovoid, 11-16 mm. long, only its base enclosed in the calyx-tube. Seeds 1 mm. long.

Stem stiffly branched. Leaves all spreading, the upper smaller but not excessively reduced, those of the stem 2-6 cm. long. Pedicels 4-20 mm. long, conspicuous when in flower. Calyx-tube glandular-hirsute to -lanose. Corolla 30-40 mm. long. Anther-sacs ovate.

2. *A. pectinata*.

Stem virgately branched. Leaves, at least the upper, appressed-ascending, uppermost leaves very much reduced, those of the stem 1.5-3 (-4) cm. long. Pedicels 4-9 mm. long, usually very short when in flower. Calyx-tube glandular-lanose. Corolla 38-45 mm. long. Anther-sacs lanceolate-ovate.

2a. *A. pectinata floridana*.

Perennials. Not glandular. Leaves entire to somewhat coarsely bipinnatifid, not pectinately cut. Calyx-lobes entire to dentate. Corolla externally glabrous, within glabrous or diffused-pubescent; not marked nor tinged with purple-red. Anther-sacs 4-6 mm. long. Capsule ovate to globose-ovate in outline, not glandular. Seeds 1.3-2.7 mm. long, strongly winged.

(*Aureolaria*, sensu strictu.)

Capsule densely rusty-pubescent. Pedicels 1.5-3 mm. long.

Stem puberulent to pubescent, at least above.

Stem puberulent to pubescent throughout. Leaves permanently downy-pubescent. Capsule 12-15 mm. long. Seeds 1.5-1.8 mm. long.

3. *A. virginica*.

Stem glabrous below, more or less puberulent above. Leaves puberulent becoming glabrous. Capsule 9-12 mm. long. Seeds 1.3-1.5 mm. long.

4. *A. microcarpa*.

Capsule glabrous. Pedicels 3-25 mm. long. Stem glabrous to minutely puberulent.

Bracts entire to finely crenate-serrate. Pedicels slender, 15-25 mm. long.

5. *A. patula*.

Bracts entire to coarsely dentate. Pedicels stouter, 3-15 mm. long.

Lower leaves ovate-lanceolate in general outline, widest about the middle, not long-acuminate. Petioles evident, mostly 10-30 mm. long. Pedicels 5-15 mm. long. Calyx densely pubescent within. Corolla 35-60 mm. long. Capsule 12-24 mm. long. Seeds 2-2.7 mm. long. Stem relatively stout, frequently purple.

Stem finely puberulent, not glaucous. Pedicels and calyx externally puberulent. Anther-sacs ovate.

6. *A. dispersa*.

Stem glabrous, glaucous. Pedicels and calyx externally glabrous. Anther-sacs ovate-lanceolate.

Stem slightly glaucous. Lower leaves from nearly entire to more or less dentate or cut, rarely  $\frac{1}{2}$  distance to midrib.

7a. *A. flava reticulata*.

Stem quite glaucous. Lower leaves more or less pinately cut, lowermost somewhat bipinnatifid, mostly over  $\frac{1}{2}$  distance to midrib.

7. *A. flava*.

Lower leaves lanceolate to ovate-lanceolate, widest below the middle, long-acuminate. Petioles very short, less than 10 mm. long. Pedicels 3-8 mm. long. Calyx sparingly pubescent to glabrous within. Corolla 30-35 mm. long. Capsule 10-12 mm. long. Seeds 1.5-1.7 mm. long. Stem slender, rarely purplish, not puberulent nor glaucous.

8 *A. laevigata*.

1. *Aureolaria pedicularia* (L.) Raf.

*Gerardia pedicularia* L., Sp. Pl. 611. 1753. "Habitat in Virginia, Canada." Type not verified, but description sufficiently distinctive.

*Aureolaria pedicularia* Raf., New Fl. Amer. 2: 61. 1837.

Dry oak-woods, sandy or rocky, perhaps in the Piedmont of North Carolina.<sup>12</sup> Ranges from Maine to Virginia (and Minnesota).

Flowering in August and September, fruiting September and October. Corolla yellow, externally more or less tinged with reddish, within at times with some purple-red spotting.

1a. *Aureolaria pedicularia carolinensis* Pennell.

*Aureolaria pedicularia carolinensis* Pennell, Bull. Torr. Bot. Club 40: 413. 1913. "Type, savannahs near Mill Pond, Wilmington, North Carolina, June 23, 1909, J. M. Macfarlane in Herb. University of Pennsylvania."

Dry sandy oak and mixed woods, pine-barrens of southeastern North Carolina.

Pennell (North Carolina)—4925.

1b. *Aureolaria pedicularia austromontana* Pennell, var. nov.

Stem glandular-pubescent to -hirsute above, with spreading short hairs, and among these, usually outnumbering them and exceeding them in length, gland-tipped hairs, so that stem is very glandular. Leaf-blades tending to lanceolate ovate, mostly deeply and sharply cut, finely puberulent with gland tipped hairs, more rarely evidently glandular-pubescent. Pedicels in flower 10-20 mm. long, in fruit (12-)18-25 mm. long. Calyx relatively sparingly pubescent with gland-tipped hairs, its lobes 10-16 mm. long, linear-lanceolate to lanceolate, relatively deeply lobed. Capsule 11-14 mm. long, broadly ellipsoid.

<sup>12</sup> *Aureolaria pedicularia caesariensis* Pennell, Bull. Torr. Bot. Club 40: 413, 1913, with leaves 1.2-5 cm. long, pedicels longer than bracts and stem not glandular hirsute below, has been found in woodland in Orange Co., N. C.

Type, Biltmore, North Carolina, collected in flower August 27, 1897, Biltmore Herbarium 481; in United States National Herbarium.

Dry oak or mixed woodland, on mountain-slopes, eastern and western Appalachians, from southwestern Virginia and southeastern Kentucky to northern Georgia.

This differs from *Aureolaria pedicularia ambigens* (Fernald) Farwell of the southern Lake region in its leaves narrower, more deeply and sharply cut, and its calyx-lobes longer and more deeply lobed. Pennell (Tennessee)—5725.

**2. *Aureolaria pectinata* (Nutt.) Pennell.**

*Gerardia pedicularia pectinata* Nutt., Gen. Pl. N. Amer. 2: 46. 1818. "Hab. In the sandy pine forests of Carolina and Georgia." Specimen of Nuttall's collecting in the British Museum, labeled "*Gerardia millefolia* S. Carol.?" may represent the type. It is determined by Dr. S. Moore as the form now considered, agreeing with my number 5638 from Louisiana.

*Aureolaria pectinata* (Nutt.) Pennell, Bull. Torr. Bot. Club 40: 414. 1913.

Dry sandy pine and oak lands, especially hilly, through the Coastal Plain from South Carolina to northwestern Florida and Louisiana; extending inland on sandy soils (as the granite of central Georgia), to westernmost North Carolina and eastern Tennessee, and through the Mississippi Valley westward in our area. Ranges northward to Kentucky and southern Missouri. The inland forms have larger leaves and fruit, and probably represent several geographic varieties, an enumeration of which will be given in the writer's "Agalinis and Allies in North America."

Flowering from July to October, fruiting in September and October. Corolla yellow, externally more or less tinged with reddish, within not marked with purple-red.

Pennell (Georgia)—4066, 5694, 5695, 5700, 5708, 5713. (Alabama)—4532, 4625, 5689. (Tennessee)—5707, 5716.

**2b. *Aureolaria pectinata floridana* Pennell.**

*Aureolaria pectinata floridana* Pennell, Bull. Torr. Bot. Club 40: 414. 1913.

"Type, Fort Gadsden, Franklin Co., Florida, Sept. 20, 1912, F. W. Pennell 4683, in Herb. University of Pennsylvania."

Dry sandy pineland, through the flatwoods of southern Georgia to central Florida.

Pennell (Georgia)—4724. (Florida)—4683.

**3. *Aureolaria virginica* (L.) Pennell.**

*Rhinanthus virginicus* L., Sp. Pl. 603. 1753. "Habitat in Virginia."

Type, Clayton 488, is identified by Dr. S. F. Blake, in *Rhodora* 20: 66. 1918, as the plant here considered.

*Aureolaria villosa* Raf., New Fl. Amer. 2: 59. 1837. No type locality stated, nor type known to exist. Description sufficiently distinctive.

*Dasystoma pubescens* Benth., in DC. Prod. 10: 520. 1846. "In Americae sept. civitatibus orientalibus frequens." Type not verified, but description sufficiently distinctive.

*Dasystoma brachycarpa* Small, Bull. Torr. Bot. Club 28: 452. 1901. "The specimens on which this species is based were collected by the writer on the slopes of Stone Mountain, Georgia, Sept. 6-12, 1894." Type seen in Herb. New York Botanical Garden. Also collected by myself at Stone Mountain, Pennell 4050, 5692. The short capsules of this plant are quite within the normal range of variation of *Aureolaria virginica*.

*Aureolaria virginica* (L.) Pennell, Bull. Torr. Bot. Club 40: 409. 1913.

Dry open woods, usually sandy, frequent through the Piedmont and eastern Appalachians south to central Georgia, less common through the western Appalachians and Mississippi Valley of our area; occasional in the Coastal Plain south to northern Florida and west to Louisiana. Ranges from New Hampshire, south to Florida and Louisiana. This species has been long known as "*Gerardia flava*."

Flowering from late May to July, fruiting from July to September. Corolla yellow, with no tinge of purple-red.

Pennell (Georgia)—4050, 4070, 4090, 5691, 5692, 5697, 5702. (Tennessee)—5724.

4. *Aureolaria microcarpa* Pennell, sp. nov.

Perennial. Stem 6-10 dm. tall, simple or with stiff ascending branches above, below glabrous, above less or more densely puberulent with recurved-spreading dark-jointed hairs. Petioles more or less defined from the narrowed base of the leaves. Lower leaves lanceolate-ovate, somewhat deeply and coarsely sinuate-lobed or merely shallowly dentate, 6-11 cm. long, 15-40 mm. wide; upper leaves gradually smaller and simpler, bracts ovate-lanceolate; leaves above scabrous-puberulent, beneath softly puberulent, becoming nearly or quite glabrous, above dull-green, beneath paler. Pedicels stout, closely pubescent, in flower 1-2 mm. long, in fruit 2-3 mm. long. Calyx externally closely puberulent, its tube 3-5 mm. long, turbinate, within puberulent, its lobes 3.5-7 mm. long, lanceolate to spatulate-ovate, acute to acutish. Corolla 30-40 mm. long, its tube inflated ventrally, its lobes 5-10 mm. long, ovate-orbicular, rounded; externally glabrous, within sparingly pubescent proximally, but glabrous below sinuses of lobes; yellow, with no tinge of purple-red. Filaments slender, flattened, posterior 13-17 mm. long, anterior 18-23 mm. long, all loosely lanose near base and again distally, especially close to the apex; anther-sacs 4-4.5 mm. long, ovate, broadly narrowed at apex into a rigid downcurved awn .8-.9 mm. long; sacs lanose-pubescent with retrorse white hairs. Style 25-30 mm. long. Capsule 9-12 mm. long, ovate to globose-ovate in out-

line, acute to acuminate, brownish, densely rusty-pubescent with reflexed-appressed brown hairs. Seeds 1.3–1.5 mm. long, broadly angular-lunate, flattened; testa gray, with reticulations dark, produced on outer side into several thin wings  $\frac{1}{4}$ – $\frac{1}{2}$  diameter of seed.

Type, Stevenson, Jackson Co., Alabama, collected in fruit October 17, 1913, F. W. Pennell 5720, in Herb. University of Pennsylvania.

Dry oak-woods, on siliceous soil, southeastern Tennessee to southern Alabama and northwestern Florida, especially in the southern Cumberland Mountains.

Flowering from early June to late August, fruiting August to October.

Pennell (Georgia)—5711. (Alabama)—5720, 9739, 9742. (Tennessee)—5703, 5706, 5715.

5. *Aureolaria patula* (Chapm.) Pennell, comb. nov.

*Dasystoma patula* Chapm. Bot. Gaz. 3: 10. 1878. "Valley of the Coosa River, near Rome, Georgia." Several collections of Chapman's seen, one labeled "Banks of Horse-leg Creek, a tributary of the Coosa River," in Herb. New York Botanical Garden, may stand as the type.

Wooded bluffs along rivers, central and eastern Tennessee, and northwestern Georgia.

Flowering from August to October. Corolla yellow, with no tinge of purple-red.

Pennell (Tennessee)—5722.

6. *Aureolaria dispersa* (Small) Pennell.

*Dasystoma dispersa* Small, Bull. Torr. Bot. Club 28: 452. 1901. "Louisiana: Feliciana, Carpenter; type in the herbarium of Columbia University." Type seen in Herb. Columbia University at the New York Botanical Garden.

*Aureolaria dispersa* (Small) Pennell, Bull. Torr. Bot. Club 40: 411. 1913.

Sandy thickets and oak-land, pineland from southern Alabama to Louisiana.

Flowering in August and September, fruiting in October.

Pennell (Alabama)—4504, 4521. (Mississippi)—4384. (Louisiana)—4117, 4245.

7. *Aureolaria flava* (L.) Farwell.

*Gerardia flava* L., Sp. Pl. 610. 1753. "Habitat in Virginia, Canada." Specimen in Linnean Herbarium identified by Bentham; see in Comp. Bot. Mag. 1: 198. 1836.

*Gerardia quercifolia* Pursh, Fl. Amer. Sept. 2: 423. pl. 19. 1814. "On the banks of rivers in rich shady places: Pennsylvania to Carolina." Type not verified, but description sufficiently distinctive.

*Aureolaria flava* (L.) Farwell, Rep. Mich. Acad. Sci. 20: 188. 1918.

Oak woodland, usually on rocky hillsides, loam or sometimes sandy soil, nearly throughout above the Fall-Line, common in the

southern Appalachians; scarcely entering the southern Coastal Plain, where it passes into the following variety. In the southwestern Appalachians and westward, largely replaced by several ill-defined varieties, to be characterized in the writer's monograph of this group. This species has been known as "*Gerardia virginica*" and "*Dasytoma virginica*."

Flowering from mid-July to mid-September, fruiting late August to October. Corolla yellow, with no tinge of purple-red.

Pennell (Georgia)—4109, 5693, 5712. (Alabama)—5688, 9728, 9750. (Tennessee)—5704, 5718.

7a. *Aureolaria flava reticulata* (Raf.) Pennell, comb. nov.

*Aureolaria reticulata* Raf., New Fl. Amer. 2: 59. 1837. "Florida and Alabama." No type known to exist.

*Dasytoma bignoniiflora* Small, Bull. N. Y. Bot. Gard. 1: 285. 1899. "Collected by Dr. Burrows, at Tampa Bay, Florida, in 1834." Type seen in Herb. Columbia University at the New York Botanical Garden.

Sandy ravines and moist woodland, in the Coastal Plain from Maryland to central Florida. Replaces the species in the southern Coastal Plain.

Flowering from late-August to mid-October, fruiting in September and October.

Pennell (South Carolina)—4875. (Georgia)—4723, 4765. (Florida)—4565, 4566, 4696, 4698, 4720, 9703.

8. *Aureolaria laevigata* (Raf.) Raf.

*Gerardia levigata* Raf., Ann. Nat. 13. 1820. "It grows on the knob hills of Kentucky, the Cumberland mountains and the Alleghany." Specimen in Herb. Columbia University at the New York Botanical Garden labeled in Rafinesque's handwriting "*Gerardia*—n. sp.—Kentucky," may be the type. Description sufficiently distinctive.

*Aureolaria levigata* (Raf.) Raf., New Fl. Amer. 2: 59. 1837.

Rocky oak-woods, along streams or on mountain-sides, frequent or common through the Appalachians south to northwestern South Carolina and eastern Tennessee. Ranges northward to Pennsylvania.

Flowering from late July to early September, fruiting in September and October. Corolla yellow, with no tinge of purple-red.

Pennell (Tennessee)—5721, 5726, 9791.

32. *AGALINIS* Rafinesque.

*Agalinis* Raf., New Fl. Amer. 2: 61. 1837.

Type species, *A. palustris* Raf.

Perennial, from a running rootstock. Pedicels erect. Corolla slightly fleshy, pink with darker spots, but with no yellow lines within throat. (*Linifoliae*.) 1. *A. linifolia*.

Annuals, fibrous-rooted. Pedicels ascending or spreading. Corolla membranous, rose-pink, mostly with darker spots and two yellow lines within throat on the anterior side.

Corolla with lobes all spreading, pubescent within at base of posterior lobes, externally more or less pubescent.

Seeds dark-brown. Plants tending to blacken in drying. Calyx-tube not decidedly reticulate-venose. (*Purpureæ*.)

Leaves uniform, linear to filiform-linear.

Inflorescence of elongated normal racemes; pedicels less than 12 mm. long. Seed-coat with dark-brown ridges, between which mostly paler and minutely reticulate.

Leaves and calyx-lobes obtuse to acutish. Anther-sacs obtuse to acutish at distal apex. Plant fleshy, bushy-branched below with elongated racemes above. Pedicels 5-12 mm. long. 2. *A. spiciflora*.

Leaves and calyx-lobes acute to acuminate. Anther-sacs mucronate to caudate at distal apex. Plants not fleshy, more uniformly branched. Pedicels .5-5(-8) mm. long.

Corolla rose-pink to pink, two yellow lines and almost always darker spots within throat evident. Capsule 4-7 mm. long. Plants dull-green or purplish.

Stem smooth or minutely scabrellous. Axillary fascicles not or slightly developed, if present shorter than the leaves. Seeds .6-1.5 mm. long.

Corolla 20-38 mm. long, deeper rose-pink.

Axillary fascicles slightly developed. Pedicels 3-8 mm. long. Seeds .9-1.5 mm. long; areas between reticulations mostly paler, and intrareticular lines discernible.

Stem relatively stiffly branched, sparingly scabrellous. Calyx-lobes triangular-lanceolate to -subulate. Corolla 20-38 mm. long. 3. *A. purpurea*.

Stem slender, virgately branched, glabrous. Calyx-lobes triangular-subulate to subulate. Corolla 20-25 mm. long.

4. *A. virgata*.

Axillary fascicles scarcely or not developed. Pedicels 2-3 mm. long. Seeds .9-1 mm. long; areas between reticulations nearly black, and no intrareticular lines discernible.

5. *A. pinetorum*.

Corolla 15-18 mm. long, paler rose-pink. Flowers nearly sessile, on pedicels less than 2 mm. long. 6. *A. harperi*.

Stem more or less scabrous. Axillary fascicles usually abundantly developed, mostly equaling the leaves. Seeds .5-.8 mm. long.

7. *A. fasciculata*.



Corolla lavender-pink, no yellow lines nor darker spots evident within throat. Capsule 3.5–5 mm. long. Plant bright-green, little darkening in drying. Stem smooth or nearly so. Axillary fascicles abundantly developed.

8. *A. georgiana*.

Inflorescence usually of short or much broken racemes (if elongated and normal, pedicels over 10 mm. long), usually some flowers by slower or arrested growth of stem-apex appearing terminal. Pedicels 5–50 mm. long.

Stem scabrous. Corolla pubescent within in narrow line below sinus of posterior lobes. Anther-sacs strongly mucronate-caudate at distal apex, densely lanose with pink hairs on the sides. Seed-coat with dark-brown reticulations, areas between these more or less hexagonal, pale and not reticulated. Stem-leaves opposite, axillary fascicles abundantly developed. Pedicels 25–40 mm. long. Corolla 25–30 mm. long.

9. *A. pulchella*.

Stem glabrous or essentially so. Corolla pubescent within over entire width of basal portions of posterior lobes. Anther-sacs acute to minutely mucronate-caudate at distal apex, glabrous over much of dorsal surface. Seed-coat with dark-brown reticulations, areas between these elongated, scarcely paler, and scarcely or not reticulated.

Stem-leaves alternate, widening distally, slightly fleshy. Axillary fascicles abundantly developed. Stigma 3.5–5.5 mm. long. Pedicels 20–35 mm. long. Corolla 22–28 mm. long.

10. *A. filifolia*.

Stem-leaves all opposite, not widening distally, not fleshy. Axillary fascicles not or scarcely developed. Stigma 1–2 mm. long.

Branches very widely and laxly ascending. Pedicels 25–50 mm. long, very slender, four or five times as long as the bracts. Corolla 15–18 mm. long, paler rose-pink. Seeds .3–.5 mm. long.

11. *A. laxa*.

Branches more closely and stiffly ascending. Pedicels 4–40 mm. long, less than twice as long as the bracts. Corolla 15–30 mm. long, deeper rose-pink. Seeds .5–.9 mm. long.

Leaves 2–3.5 cm. long, equaling or exceeding the internodes, slightly scabrous to glabrous above.

Pedicels 15–40 mm. long, longer than the bracts. Calyx-tube  $\frac{3}{4}$ – $\frac{1}{2}$  the length of the capsule.

Corolla mostly 17-25 mm. long. Capsule 3-4 mm. long. Seeds .5-.6 mm. long. Leaves sparingly scabrous to glabrous above.

Leaves narrowly linear to filiform, .3-1.5 mm. wide. Racemes mostly somewhat developed, so flowers not conspicuously "terminal." Pedicels 15-40 mm. long. Calyx-lobes .2-.5 mm. long. Corolla 18-25 mm. long. Seeds rounded, turgid, with reticulations very fine, relatively close.

12. *A. holmiana*.

Leaves filiform-setaceous, .1-.3 mm. wide. Racemes scarcely developed, so flowers conspicuously "terminal." Pedicels 15-20 mm. long. Calyx-lobes .1-.3 mm. long. Corolla 17-20 mm. long. Seeds angled, with reticulations less fine and more remote.

13. *A. stenophylla*.

Pedicels 5-10 (-15) mm. long, shorter than or equaling the bracts. Calyx-tube  $\frac{1}{2}$ - $\frac{3}{4}$  the length of the capsule. Corolla mostly 25-30 mm. long. Capsule 4-5 mm. long. Seeds .6-.8 mm. long. Leaves slightly scabrous above. Flowers conspicuously "terminal."

14. *A. setacea*.

Leaves .5-1.2 cm. long, shorter than the internodes, scabrous above. Corolla 15-22 mm. long.

Stem slightly striate-four-angled, sparingly scabrellous to glabrous. Leaves filiform, .8-1.2 cm. long. Pedicels 4-6 mm. long, about equaling the bracts. Calyx-lobes not becoming callose.

15. *A. keyensis*.

Stem nearly terete, striate-ridged, minutely hispidulo-roughened on the ridges. Leaves linear-subulate, .5-1 cm. long. Pedicels 4-15 mm. long, three to six times the length of the bracts. Calyx-lobes becoming more or less callose.

16. *A. oligophylla*.

Leaves dimorphic, those near the base of the stem oval ovate, spreading, the cauline minute, scale-like, appressed. Pedicels 1.5-3 mm. long (many flowers appearing to terminate minute axillary branchlets). Calyx-lobes minute, subulate, callose. Corolla 15-20 mm. long. Stem striate-four-angled, ridged, minutely hispidulo-roughened on the ridges, often pubescent at base.

17. *A. aphylla*.

Seeds yellowish-brown. Plants not tending to blacken in drying. Calyx-tube evidently reticulate-venose. (*Erectæ*.)

Stem evidently striate-four-angled, simple to moderately branched. Leaves linear to nearly filiform, 1-2.5 cm. long. Racemes well-developed, so flowers not conspicuously "terminal." Stigma 1-2 mm. long.

Leaves linear to nearly filiform, not widening distally, acutish to acuminate. Corolla with two yellow lines and purple-red spots within throat strongly defined. Capsule globose to globose-ovoid, somewhat flattened at base.

Leaves 2-2.5 cm. long, filiform-linear, relatively scabrous above. Pedicels one to three times the length of the bracts. Corolla 13-15 mm. long. Seeds .6-.8 mm. long. 18. *A. decemloba*.

Leaves 1-1.5 (-2) cm. long, linear-filiform to nearly filiform, slightly scabrous above. Pedicels mostly three to eight times the length of the bracts. Corolla 15-20 mm. long. Seeds .9-1.1 mm. long.

19. *A. tenella*.

Leaves linear, widening distally, acutish to obtuse, 1-1.5 (-1.8) cm. long. Corolla with lines and spots within throat faint or obsolete. Capsule globose-ovoid to globose-elliptic, rounded at base. Corolla 12-16 mm. long.

20. *A. erecta*.

Stem nearly terete, much branched. Leaves narrowly linear, 2-3 cm. long. Racemes scarcely developed, so flowers scattered and conspicuously "terminal." Stigma 2-3 mm. long. Corolla 12-18 mm. long.

21. *A. gattingeri*.

Corolla with posterior lobes arched over stamens and style, glabrous within at their base. (*Tenuifoliae*.)

Corolla pubescent externally, its posterior lobes about two-thirds the length of the anterior, minutely ciliate, concave-arched. Pedicels, if exceeding the bracts, less than twice their length. Corolla 10-23 mm. long, rose-pink. Leaves linear.

Corolla 15-23 mm. long.

22a. *A. tenuifolia leucanthera*.

Corolla 10-15 mm. long.

Leaves linear, 1-6 mm. wide, those of the stem obviously wider than those of the branches.

Calyx-lobes mostly 1-2 mm. long. Capsule mostly 5-7 mm. long. Seeds .7-1.3 mm. long, with reticulations more pronounced. Leaves 1-6 mm. wide.

22b. *A. tenuifolia macrophylla*.

Calyx-lobes mostly less than 1 mm. long. Capsule mostly 3-4 mm. long. Seeds .6-.9 mm. long, with reticulations very fine. Leaves 1-3.5 mm. wide.

22. *A. tenuifolia*.

Leaves linear-filiform to filiform, .3-1 mm. wide, those of the stem scarcely wider than those of the branches.

22c. *A. tenuifolia polyphylla*.

Corolla glabrous externally, its posterior lobes less than one-half the length of the anterior, conspicuously ciliate, flattened. Pedicels at least three times the length of the bracts.

Leaves filiform, those of the stem 1.5-2 cm. long. Racemes well-developed, so flowers not appearing "terminal." Pedicels 20-32 mm. long, three to twelve times the length of the bracts. Corolla 15-18 mm. long, rose-pink. Plant widely much branched.

23. *A. divaricata*.

Leaves minute, triangular-subulate, .1-.2 cm. long. Flowers scattered, mostly appearing "terminal." Pedicels 6-10 mm. long, many times the length of the bracts. Corolla 10-13 mm. long, lavender-pink. Plant sparingly very laxly branched.

24. *A. filicaulis*.

1. *Agalinis linifolia* (Nutt.) Britton.

*Gerardia linifolia* Nutt., Gen. Pl. N. Amer. 2: 47. 1818. "Hab. From Wilmington, North Carolina, to Florida." Type, labeled "Carolina," and collected by T. Nuttall, seen in Herb. Academy of Natural Sciences of Philadelphia.

*Agalinis perennis* Raf., New Fl. Amer. 2: 63. 1837. "My specimen is from Florida." Type not known to exist, but description quite distinctive.

*Agalinis linifolia* (Nutt.) Britton; Britton & Brown, Ill. Fl. ed. II. 3: 209. 1913.

Wet sandy pineland, usually about margins of ponds in long-leaf pineland, in the Coastal Plain from North Carolina to southern Florida and west to Louisiana. Northward occurs in southern Delaware.

Flowering from mid-August to October, fruiting September to November. Corolla pink, with no yellow lines but with diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4729, 4745, 4790, 4823. (Florida)—4600, 4648, 4654, 4666, 4690, 4714, 4794, 4807, 4813.

2. *Agalinis spiciflora* (Engelm.) Pennell, comb. nov.

*Gerardia maritima grandiflora* Benth., Comp. Bot. Mag. 1: 208. 1836. "Texas, Drummond, (1st Coll.);" Type in Kew Herbarium verified by Dr. N. E. Brown as agreeing with my number 4702 from Florida; isotype seen in Herb. Columbia University at the New York Botanical Garden.

*Gerardia spiciflora* Engelm., Bost. Journ. Nat. Hist. 5: 227. 1845. New name for *Gerardia maritima grandiflora* Benth.

*Gerardia maritima major* Chapm., Fl. S. Un. St. 300. 1860. "Brackish marshes, Apalachicola, Florida." Different collections of this, made by Dr. Chapman, seen.

Salt marshes, along the coast from North Carolina to Texas. Ranges through the West Indies and on the shore of Yucatan. Prob-

ably not specifically distinct from the northern smaller ally, *A. maritima* (Raf.) Raf.

Flowering from March to September, and soon ripening fruit; in subtropical Florida flowering and fruiting throughout the year. Corolla pink, with two yellow lines and many small purple-red spots within throat anteriorly.

Pennell (Florida)—4702, 9550, 9561.

**3. *Agalinis purpurea* (L.) Pennell.**

*Gerardia purpurea* L., Sp. Pl. 610. 1753. "Habitat in Virginia, Canada." Linnean diagnosis includes long- and short-pedicelled plants, so could include any pink (= "purple") flowered species. The first citation accompanied by a figure, Plukenet's *Digitalis virginiana rubra, foliis & facie Antirrhini vulgaris*, evidently the prevalent plant of the Atlantic seaboard, is considered as the type.

*Agalinis palustris* Raf., New Fl. Amer. 2: 62. 1837. "Near marshes. . . . From New England to Carolina." Type not known to exist, but characterization evidently of the common species of the Atlantic seaboard.

? *Agalinis corymbosa* Raf., l. c. 63. 1837. "Carolina and Florida." Type not known to exist; either the species now considered or a near ally.

*Agalinis purpurea* (L.) Pennell, Bull. Torr. Bot. Club 40: 126. 1913.

Moist sandy soil, edges of salt-marsh, of ponds or of rivers, depressions in sand-dunes, or locally on barren soil, common and locally abundant through the Coastal Plain, especially near the coast, along rivers and sand-hills, locally absent or replaced by derivative species in the longleaf pine belt; southward in a modified form to extreme southern Florida; inland much less frequent, although ascending river-valleys into the southern Appalachians. Ranges from Massachusetts to Florida, Minnesota, Nebraska and Texas.

Flowering from mid-July to mid-September, and soon ripening fruit. Corolla rose-pink, with two yellow lines and many small diffused purple-red spots within throat anteriorly.

Pennell (North Carolina)—4914, 4927, 4932, 4948. (South Carolina)—4850, 4854, 4869, 4876. (Georgia)—4735a, 4746, 4753, 4758, 4767, 4769, 4784, 4811. (Florida)—4703, 4799, 4806. (Mississippi)—4357.

**4. *Agalinis virgata* Raf.**

*Agalinis virgata* Raf., New Fl. Amer. 2: 62. 1837. "Glades of pine woods in South New Jersey near Mullica Hill, etc." Type not known to exist.

Moist sandy pine barrens, in the Coastal Plain south to South Carolina. Ranges northward to Long Island.

Flowering from September to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and diffused purple-red spots within throat anteriorly.

Pennell (North Carolina)—4902, 4921. (South Carolina)—4877.

5. *Agalinis pinetorum* Pennell.

*Agalinis pinetorum* Pennell, Bull. Torr. Bot. Club 40: 424. 1913. "Type, St. Marks, Wakulla Co., Florida, Sept. 26, 1912, F. W. Pennell 4708, in Herb. University of Pennsylvania."

*Agalinis delicatula* Pennell, l. c. 425. 1913. "Type, Ponce de Leon, Holmes Co., Florida, Sept. 17, 1912, F. W. Pennell 4661 in Herb. University of Pennsylvania." A distinct-seeming plant, with leaves more slender, filiform, curling in drying, and corolla within not spotted with purple-red. Until known from other stations not maintained as a species.

Moist soil in longleaf pineland, and on coastal prairie, southern Georgia and northern Florida to Louisiana.

Flowering in September and October, and soon ripening fruit. Corolla pink, with two yellow lines and purple red spots within throat anteriorly.

Pennell (Georgia)—4734, 4738, 4750, 4770, 4771, 4773, 4775, 4781, 4791. (Florida)—(4661 *delicatula*), 4688, 4708, 4795.

6. *Agalinis harperi* Pennell.

*Agalinis harperi* Pennell; Small, Fl. Miami 167, 200. 1913. "Type, St. Marks, Wakulla County, Florida, F. W. Pennell 4707." Type, collected September 25, 1912, seen in Herb. University of Pennsylvania.

Moist sandy pineland and borders of salt-marshes, longleaf pineland, from southern Georgia south to the Everglades of southern Florida. Also on the Bahamas.

Flowering northward from mid-September to October, and soon ripening fruit, southward flowering and fruiting throughout the year. Corolla pale rose-pink, with two yellow lines and small purple-red spots mostly along these lines within throat anteriorly. This has been confused with the northern "*Gerardia paupercula*."

Pennell (Georgia)—4726, 4810. (Florida)—4701, 4707, 4711.

7. *Agalinis fasciculata* (Ell.) Raf.

*Gerardia fasciculata* Ell., Sketch Bot. S. C. and Ga. 2: 115. 1822. "Grows principally in lands subject to occasional inundation from the ocean . . . on Eding's Island near Beaufort very common." Type seen in the Elliott Herbarium at the Charleston Museum.

*Agalinis fasciculata* (Ell.) Raf., New Fl. Amer. 2: 63. 1837.

Moist to dry sandy loam or clay soil, in depressions among sand-dunes, edges of salt-marsh, or loam soil in limestone districts; the only species of cultivated fields; locally common through the Coastal Plain from South Carolina to southern Florida and westward near the Gulf Coast. Ranges westward to Texas and southern Missouri. In southern Florida represented by a variant with less scabrous stem.

Flowering from August to October and soon ripening fruit. Corolla pink, with two yellow lines and many diffused purple-red spots within throat anteriorly.

Pennell (North Carolina)—4949. (South Carolina)—4849, 4860, 4863, 4868. (Georgia)—4735, 4740, 4747, 4751, 4755, 4761, 4766, 4772, 4792, 4818. (Florida)—4669, 4675, 4680, 4695, 4697, 4706, 4717, 4718, 4793, 9544, 9562. (Mississippi)—4356, 4370. (Louisiana)—4267, 4276, 4303, 4304, 4330.

8. *Agalinis georgiana* (Boynton) Pennell.

*Gerardia georgiana* Boynton, Biltm. Bot. Stud. 1: 148. 1902. "In the pine barrens near Cordele, Dooly County, Georgia, in September, 1901. . . . In moist sandy soil in pine barrens. . . . The type specimens are deposited in the Biltmore Herbarium." Type, collected Sept. 18, 1901, seen in the Biltmore Herbarium.

*Agalinis georgiana* (Boynton) Pennell, Bull. Torr. Bot. Club 40: 427. 1913.

Dry sandy or clay soil, in longleaf pineland, southern Georgia, southern Alabama and northern Florida.

Flowering from mid- to late-September, and soon ripening fruit. Corolla lavender-pink, without yellow lines or purple-red spots within throat anteriorly.

Pennell (Georgia)—4728, 4739. (Florida)—4586, 4662, 4665, 4693. (Alabama)—4609, 4629, 4632.

9. *Agalinis pulchella* Pennell.

*Agalinis pulchella* Pennell, Bull. Torr. Bot. Club 40: 428. 1913. "Type, Ponce de Leon, Holmes Co., Florida, Sept. 17, 1912, F. W. Pennell 4658, in Herb. University of Pennsylvania."

Dry open sandy longleaf pineland, southern Georgia and northern Florida, westward to Louisiana.

Flowering in September, fruiting in October. Corolla rose-pink, with two yellow lines and relatively large longitudinal purple-red spots within throat anteriorly.

Pennell (Georgia)—4731, 4776, 4779. (Florida)—4587, 4650, 4658, 4663, 4692. (Alabama)—4427, 4452, 4454, 4455, 4493, 4515, 4642.

10. *Agalinis filifolia* (Nutt.) Raf.

*Gerardia filifolia* Nutt., Gen. Pl. N. Amer. 2: 48. 1818. "Hab. In West Florida. Dr. Baldwyn." No type in the herbarium of the Academy of Natural Sciences of Philadelphia, but the description is quite distinctive.

*Agalinis filifolia* (Nutt.) Raf., New Fl. Amer. 2: 65. 1837.

Rather dry sandy longleaf pineland, in the Coastal Plain from southern Georgia southward to southern Florida.

Flowering in September and early October, and soon ripening fruit. Corolla rose-pink, with two yellow lines and diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4741, 4752, 4785, 4821, 4828, 10174. (Florida)—4671, 4673, 4694, 4800, 4803.

**11. *Agalinis laxa* Pennell.**

*Agalinis laxa* Pennell, Bull. Torr. Bot. Club 40: 431. 1913. "Type, Brunswick, Glynn Co., Georgia, Oct. 10, 1912, F. W. Pennell 4824, in Herb. University of Pennsylvania."

Dry sandy longleaf pineland, or more especially on river-sandhills and old dunes, near the coast, South Carolina to central Florida.

Flowering in late September and October, and soon ripening fruit. Corolla pink, with two yellow lines and, especially along these, small purple-red spots within throat anteriorly.

Pennell (South Carolina)—4880. (Georgia)—4778, 4783, 4824. (Florida)—4801, 4805.

**12. *Agalinis holmiana* (Greene) Pennell.**

*Gerardia holmiana* Greene, Pittonia 4: 52. pl. 10. 1899. "Plentiful in open pine and oak groves along Michigan Avenue south of the Soldiers' Home grounds near Brookland, D. C., collected by Mr. Holm and the writer, 20 Oct., 1898." Probable type seen in the herbarium of the New York Botanical Garden, and I have myself collected the plant at the type station.

*Agalinis holmiana* (Greene) Pennell, Bull. Torr. Bot. Club 40: 429. 1913.

Dry sandy pineland, in the Coastal Plain; near the coast south to South Carolina, and apparently in the sand-hills near the Fall-Line southwestward into Georgia. Ranges northward to Long Island, New York.

Flowering from late August to mid-October, and soon ripening fruit. Corolla rose-pink, with two yellow lines, and, especially along these, small purple-red spots within throat anteriorly.

Pennell (North Carolina)—4904, 4923, 4929. (South Carolina)—4864.

**13. *Agalinis stenophylla* Pennell, sp. nov.**

Plant dull-green or purplish, tending to blacken in drying. Stem 6-7 dm. tall, slender, with many ascending branches, essentially glabrous. Leaves ascending-spreading, filiform-setaceous, entire, acuminate, those of the stem 2-3 cm. long, .1-.3 mm. wide; scabro-roughened to glabrous above. Axillary fascicles scarcely or not developed. Racemes scarcely elongate, often broken, usually but one flower of each pair developed, 1-6 flowered. Pedicels ascending, glabrous, in flower 8-12 mm. long, in fruit 15-20 mm. long, 2-2.5 times the length of the bracts, some on all the branches appearing "terminal." Calyx-tube 2.5 mm. long, hemispheric-campanulate,  $\frac{2}{3}$ - $\frac{1}{2}$  the length of the capsule, truncate, its lobes .1-.3 mm. long, triangular-subulate, not callose. Corolla 17-20 mm. long; its tube 11-17 mm. long, slightly upcurved, its lobes 6-7 mm. long, rounded to retuse, all spreading; externally minutely pubescent,



within pubescent below sinus and over entire width of basal portions of posterior lobes; probably rose-pink (not seen fresh). Anthers 1.7–2 mm. long, lanceolate, acuminate at distal apex, lanate with white hairs on the valvular surface. Style glabrous. Stigma 1.5–2 mm. long. Capsule 3–4 mm. long, globose-ovoid, dark-brown. Seeds .5–.6 mm. long; testa dark-brown to nearly black, with reticulations heavy and relatively remote; intra-reticular lines not discernible.

Type, Tampa, Florida, collected in flower and young fruit October, 1877, A. P. Garber 281; in Herb. Academy of Natural Sciences of Philadelphia.

Known only from the original collection.

14. *Agalinis setacea* (Walt.) Raf.

*Anonymos setacea* Walt., Fl. Car. 170. 1788. Supposedly from lower South Carolina, but probably from much further west. Type in the British Museum identified by Dr. A. B. Rendle as agreeing with my number 4757 from Cobb, Sumter Co., Georgia.

*Gerardia plukenetii* Ell., Sketch Bot. S. C. and Ga. 2: 114. 1822. "Grows in wet spongy soils, very common between the Oakmulgee and Chatahouchee Rivers." Type seen in the Elliott Herbarium at the Charleston Museum. Statement of habitat probably due to confusion with *Agalinis pinetorum* Pennell.

*Agalinis setacea* (Walt.) Raf., New Fl. Amer. 2: 64. 1837.

*Gerardia filifolia gatesii* Benth., in DC. Prod. 10: 518. 1846. "In Alabama (Gates!)." Type in the Kew Herbarium, identified, from a fragment sent me, as this species.

Dry open sandy pineland. In the Coastal Plain from western Georgia and northern Florida to eastern Mississippi, usually in long-leaf pineland; inland in pinewoods on mountain-slopes through northern Georgia and northern Alabama.

Flowering from mid-September to October, and soon ripening fruit. Corolla rose-pink, with two yellow lines and many small diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4757, 5710. (Florida)—4569, 4570, 4583, 4584, 4672. (Alabama)—4426, 4457, 4461, 4517, 4523, 4524, 4561, 4623, 5690. (Mississippi)—4382.

15. *Agalinis keyensis* Pennell, sp. nov.

Plant dull-green, tending to blacken in drying. Stem at least 7 dm. tall, slender, with many spreading-ascending branches, sparingly scabrellous or glabrous. Leaves spreading, filiform, entire, acuminate, those of the stem (lowest not seen) .8–1.2 cm. long, .2–.4 mm. wide; scabrous above. Axillary fascicles none. Racemes not elongate, much broken and but one flower of each pair developed, 1–4 flowered. Pedicels ascending, glabrous, in flower 3–4 mm. long, in fruit 4–6 mm. long, about equaling the bracts, some

on all the branches appearing "terminal." Calyx-tube 2.5-3 mm. long, hemispheric,  $\frac{1}{3}$ - $\frac{2}{3}$  the length of the capsule, truncate, its lobes .4-.6 mm. long, triangular-subulate, not becoming callose. Corolla 18-20 mm. long; its tube 14-15 mm. long, slightly upcurved, its lobes 4-5 mm. long, truncate to emarginate, all spreading; externally minutely pubescent, within pubescent below sinus and over entire width of basal portions of posterior lobes; probably pink (not seen fresh). Anther-sacs 2.5 mm. long, lanceolate, cuspidate at distal apex, lanate with white hairs on the valvular surface. Style glabrous. Capsule 3-3.5 mm. long, globose, brown. Seeds .7-.9 mm. long; testa dark-brown to nearly black, with reticulations rather fine; intrareticular lines not discernible.

Type: woods, Pine Key, Florida, collected in flower and fruit by Mr. Blodgett; in herb. Columbia University at the New York Botanical Garden.

Known only from the original station in the Florida Keys. Not re-collected; Dr. Small and myself have hunted in vain for this on Pine Key, but at the time of our joint visit the season had been unusually dry.

16. *Agalinis oligophylla* Pennell.

*Gerardia aphylla grandiflora* Benth., Comp. Bot. Mag. 1: 174. 1836. "Jacksonville [Drummond]." Type, labeled "Jacksonville," [certainly an error for Louisiana], seen in Kew Herbarium.

*Gerardia plukenetii microphylla* A. Gray, Syn. Fl. N. Amer. II. 1: 293. 1878. "Louisiana, Drummond, Hale." Type, an isotype of *Gerardia aphylla grandiflora* Benth., seen in Gray Herbarium.

*Agalinis oligophylla* Pennell, Bull. Torr. Bot. Club 40: 432. 1913. New name for *Gerardia plukenetii microphylla* A. Gray.

Moist longleaf pineland, in the Coastal Plain from southern Mississippi to southeastern Texas.

Flowering from late September to late October, and soon ripening fruit. Corolla rose-pink, with two yellow lines and, mostly along these, rather large purple-red spots within throat anteriorly.

17. *Agalinis aphylla* (Nutt.) Raf.

*Gerardia aphylla* Nutt., Gen. Pl. N. Amer. 2: 47. 1818. "Hab. From North Carolina to Florida, where it was first detected by Dr. Baldwin." Type seen in herbarium of the Academy of Natural Sciences of Philadelphia.

*Agalinis microphylla* Raf., New Fl. Amer. 2: 65. 1837. "In Florida, collected by Le Conte (Collins herb.)." Type not known to exist.

*Agalinis aphylla* (Nutt.) Raf., l. c. 65. 1837.

Moist sandy longleaf pineland, near the coast, North Carolina to northern Florida and Louisiana.

Flowering from mid-September to early November, and soon ripening fruit. Corolla pale-pink, with two yellow lines but without purple red spots within throat anteriorly.

Pennell (Georgia)—4748, 4789, 4808, 4819. (Florida)—4647, 4655, 4664, 4676, 4682, 4712, 4798, 4814.

18. *Agalinis decemloba* (Greene) Pennell.

*Gerardia decemloba* Greene, Pittonia 4: 51. pl. 9. 1899. "Plant not uncommon about Brookland, D. C., inhabiting grassy knolls and hillsides bordering on pine woods." Type probably seen in Herb. New York Botanical Garden, and I have collected the plant at the type station.

*Agalinis decemloba* (Greene) Pennell, Bull. Torr. Bot. Club 40: 434. 1913.

Dry open soil, sandy or clay, southward on mountain sides, locally frequent in the Piedmont and southern Appalachians. Ranges from southeastern Pennsylvania to northern Alabama, but with a very broken distribution and wholly east of the mountains.

Flowering from late August to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and fine purple-red spots within throat anteriorly.

Pennell (Alabama)—5687. (Tennessee)—5709.

19. *Agalinis tenella* Pennell.

*Agalinis tenella* Pennell, Bull. Torr. Bot. Club 40: 434. 1913. "Type Thomasville, Thomas Co., Georgia, Sept. 28, 1912, F. W. Pennell 4727 in Herb. University of Pennsylvania."

Dry sandy pineland, in the Coastal Plain from South Carolina to north-central Florida, west to Louisiana.

■ Flowering from mid-September to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and purple-red spots within throat anteriorly.

Pennell (South Carolina)—4853, 4871. (Georgia)—4727, 4744, 4756, 4764, 4768, 4774, 4777, 4782, 4786.

20. *Agalinis erecta* (Walt.) Pennell.

*Anonymos erecta* Walt., Fl. Car. 170. 1788. Presumably from lower South Carolina; no type in the Walter herbarium in the British Museum and only identified as possibly the plant here considered.

*Gerardia setacea parvifolia* Benth., Comp. Bot. Mag. 1: 174. 1836. "Jacksonville." Drummond. Type in Kew Herbarium verified by Dr. N. E. Brown as agreeing with my number 4659 from Ponce de Leon, Florida.

*Agalinis obtusifolia* Raf., New Fl. Amer. 2: 64. 1837. "West Tennessee, Alabama and Florida." Type not known to exist. Description, and certainly the name, belongs to the plant now considered, although the Tennessee specimen could hardly belong here.

*Agalinis erecta* (Walt.) Pennell; Small, Fl. Florida Keys 133. 1913.

Moist to dry sandy pineland, mostly longleaf, usually common, in the Coastal Plain, from North Carolina to southernmost Florida, and west to Louisiana. Occurs northward in southward Delaware.

Flowering from early September to mid-October, and soon ripening fruit. Corolla pink, with the two yellow lines and purple-red spots within throat anteriorly faint or absent.

This and related species have been known as "*Gerardia skinneriana*."

Pennell (North Carolina)—4910, 4915, 4926, 4933. (South Carolina)—4870, 4879. (Georgia)—4733. (Florida)—4596, 4640, 4646, 4659, 4667, 4685, 4710, 4797, 4804, 4815. (Alabama)—4428, 4453, 4503, 4526, 4548, 4562, 4614, 4634. (Mississippi)—4363, 4399. (Louisiana)—4226, 4227, 4231.

**21. *Agalinis gattingeri* (Small) Small.**

*Gerardia tenuifolia leptophylla* Benth., Comp. Bot. Mag. 1: 174. 1836.

"Jacksonville, Louisiana." Drummond. Type, doubtless from Louisiana, seen in Kew Herbarium.

*Gerardia tenuifolia filiformis* Benth., in DC. Prod. 10: 518. 1846. "Southern States." Type labeled "Amer. bor. Rafinesque. *Gerardia filiformis* Raf.," seen in Kew Herbarium.

*Gerardia gattingeri* Small, Fl. S. E. Un. St. 1078, 1338. 1903. "Type, Curtiss N. A. Pl. no. 1910\* in Herb. C. U." Type, collected by A. Gattinger on hills around Nashville, Tennessee, seen in Herb. Columbia University at the New York Botanical Garden.

*Agalinis gattingeri* (Small) Small, in Britton & Brown, Ill. Fl. N. Un. St. and Can. ed. II. 3: 213. 1913.

Dry to moist, sandy or clayey soil, woodland, barrens or open bluffs, in central Tennessee and northern Alabama. Ranges from southwestern Ontario to Minnesota, south to Alabama and eastern Texas.

Flowering from late August to mid-October, and soon ripening fruit. Corolla pink, with two yellow lines and several to many rather large purple-red spots within throat anteriorly.

Pennell (Tennessee)—5705.

**22. *Agalinis tenuifolia* (Vahl) Raf.**

*Gerardia tenuifolia* Vahl, Symb. Bot. 3: 7. 1794. "Habitat in America septentrionali." Type in Herb. Universitetets Botaniske Museum, Copenhagen, Denmark, collected by Von Rohren, and said to be probably from Philadelphia, is identified by Dr. C. H. Ostenfeld as agreeing with my number 2681 from Pennsylvania.

*Agalinis tenuifolia* (Vahl) Raf., New Fl. Amer. 2: 64. 1837.

Loam or sandy soil, moist or dry, usually in open deciduous woodland, common throughout above the Fall-line, through the eastern Appalachians, southward smaller-leaved, passing into var. *polypphylla*, westward, mainly near river-banks, passing into var. *macrophylla*; descending into the Coastal Plain locally in heavier soils, as limestone, and in river-bottoms, there passing into var. *leucanthera*. Ranges from Maine to Michigan, south to Georgia and Louisiana.

Flowering from August to October, and soon ripening fruit. Corolla purplish-pink, with two yellow lines and small diffused purple-red spots within throat anteriorly.

Pennell (Georgia)—4091.

**22a. *Agalinis tenuifolia leucanthera* (Raf.) Pennell, comb. nov.**

*Gerardia leucanthera* Raf., Fl. Ludov. 50. 1817. Louisiana. C. C. Robin.  
Type not seen.

Stem 4–10 dm. tall, widely much branched. Pedicels .5–1.5 times the length of the bracts. Corolla 15–23 mm. long. Capsule 6–7 mm. long. Seeds apparently slightly longer and more evidently reticulate.

Usually in moist soil, loam or clay, more rarely in sand, woodland or meadow, especially near streams, in alluvial or limestone soils, in the Coastal Plain from southern Georgia and northern Florida to eastern Texas.

Pennell (Georgia)—4759. (Florida)—4601, 4670, 4699, 4721. (Alabama)—4522, 4597, 4606, 4619.

**22b. *Agalinis tenuifolia macrophylla* (Benth.) Blake.**

*Gerardia tenuifolia macrophylla* Benth., Comp. Bot. Mag. 1: 174. 1836. "St. Louis, Jacksonville." Drummond. Fragment of type, from Kew Herbarium, labeled "St. Louis," seen.

*Gerardia besseyana* Britton, Mem. Torr. Bot. Club 5: 295. 1894. New name for *Gerardia tenuifolia macrophylla* Benth., not *Gerardia macrophylla* (Nutt.) Benth.

*Agalinis tenuifolia macrophylla* (Benth.) Blake, Rhodora 20: 71. 1918.

In situations similar to that of the species, but more frequent along river-banks, from northern Alabama and Mississippi northward. Ranges from southern Ontario and Minnesota south to Alabama and Oklahoma.

Pennell (Alabama)—5719. (Mississippi)—5685. (Tennessee)—5714.

**22c. *Agalinis tenuifolia polyphylla* (Small) Pennell, comb. nov.**

*Gerardia polyphylla* Small, Bull. Torr. Bot. Club 25: 618. 1898. "The original specimens were collected by the writer on Little Stone Mountain, De Kalb County, Georgia, in September, 1895." Type seen in Herb. New York Botanical Garden.

Dry light soil over granite, locally in the granite region of central Georgia.

Pennell (Georgia)—4065, 5696, 5699.

**23. *Agalinis divaricata* (Chapm.) Pennell.**

*Gerardia divaricata* Chapm., Fl. S. Un. St. 299. Mar., 1860. "Low sandy pine barrens, West Florida." No type indicated, but numerous specimens collected and distributed by the describer seen.

*Gerardia mettauerei* Wood, Class-Book 530. Dec., 1860. "Wet sandy places, Middle Fla. (Dr. Mettauerei)." Type seen in herbarium of Columbia University at the New York Botanical Garden.

*Gerardia mettauerei clausa* Wood, l. c. 530. 1860. "With the others," that is, with the species and *G. mettauerei nuda*. No specimen so labeled seen.

*Agalinis divaricata* (Chapm.) Pennell, Bull. Torr. Bot. Club 40: 437. 1913.

Dry sandy longleaf pineland, western Florida and southeastern Alabama, mostly abundant.

Flowering in September and October, and soon ripening fruit. Corolla rose-pink, with no yellow lines but with faint purple-red spots within throat anteriorly.

Pennell (Florida)—4572, 4593, 4644, 4657, 4668, 4679, 4684, 4687, 4716. (Alabama)—4622, 4624, 4627, 4633.

**24. *Agalinis filicaulis* (Benth.) Pennell.**

*Gerardia aphylla filicaulis* Benth., Comp. Bot. Mag. 1: 174. 1836. "Jacksonville." Drummond. Type in Kew Herbarium, verified by Dr. N. E. Brown, as agreeing with my number 4660 from Florida.

*Gerardia mettauerei nuda* Wood, Class-Book 530. 1860. "Middle Fl. (Dr. Mettauerei, 1855.)" No type seen.

*Agalinis filicaulis* (Benth.) Pennell, Bull. Torr. Bot. Club 40: 438. 1913.

Moist grassy sandy longleaf pineland, in the Coastal Plain from southern Georgia and northern Florida to eastern Louisiana.

Flowering from mid September to early November, and soon ripening fruit. Corolla lavender pink, without yellow lines or purple-red spots within throat anteriorly.

Pennell (Georgia)—4749, 4788. (Florida)—4594, 4643, 4660, 4677, 4689, 4709, 4796. (Alabama)—4608, 4626.

**33. *OTOPHYLLA* Benth.**

*Otophylla* Benth., in DC. Prod. 10: 512. 1846.

Type species, *Gerardia auriculata* Michx.

**1. *Otophylla auriculata* (Michx.) Small.**

*Gerardia auriculata* Michx., Fl. Bor. Amer. 2: 20. 1803. "In pratis regionis Illinoensis [A. Michaux]." Description sufficiently distinctive.

*Otophylla michauxii* Benth., in DC. Prod. 10: 512. 1846.

*Otophylla auriculata* (Michx.) Small, Fl. S. E. Un. St. 1075, 1338. 1903.

Moist to dry prairies, old fields and waysides, known only from Jackson, Madison Co., western Tennessee, where probably introduced. Native of the prairies of the central Mississippi Valley from Michigan to Minnesota and Arkansas.

Flowering from late August to mid-September, fruiting in September and October.

**34. *BUCHNERA* Linné.**

*Buchnera* L., Sp. Pl. 630. 1753.

Type species, *B. americana* L.

Leaves 3-9 cm. long, lanceolate to ovate-lanceolate, relatively coarsely dentate. Corolla-lobes 6-9 mm. long, the tube 2-2½ times the length of the calyx. Capsule 8-9 mm. long, oblong. Stem hirsute-pubescent. 1. *B. americana*.

Leaves 2-7 cm. long, lanceolate-elliptic to linear, entire or the lower slightly dentate. Corolla-tube mostly 1-1½ times the length

of the calyx. Capsule ovate, 5–6.5 mm. long. Seeds. Stem less pubescent or even glabrate.

Leaves prevailing lanceolate-elliptic, mostly obtuse, only the uppermost at times linear and then reduced. Corolla-lobes usually 4–6 mm. long.

2a. *B. elongata obtusa*.

Leaves linear or nearly so, mostly acute to acuminate, only the lowermost if any lanceolate-elliptic. Corolla-lobes usually 6–8 mm. long.

2. *B. elongata*.

1. *Buchnera americana* L.

*Buchnera americana* L., l. c. 630. 1753. "Habitat in Virginia, Canada." Based upon Gron., Fl. Virg. 74. 1743, typified by Clayton 142 from Virginia. Description sufficiently distinctive.

Sandy or sterile loam soil, throughout the area except in the Appalachians, probably more frequent in the Coastal Plain where it may intergrade with *B. elongata obtusa*.

Flowering from June to September, and soon ripening fruit. Corolla purplish-blue throughout.

Pennell (Alabama)—4478, 4518, 4550, 4554.

2. *Buchnera elongata* Sw.

*Buchnera elongata* Sw., Prod. Veg. Ind. Occ. 92. 1788. "India occidentalis, Jamaica"; Fl. Ind. Occ. 1061. 1800, "Habitat in arenosis depressis Indiae occidentalis. Versus jugum montium paroeciae Clarendon Jamaicae."

Sandy soil, dunes and limestone pineland of southern Florida, passing into var. *obtusata*. Ranges through the West Indies, and in northern South America.

Pennell (Florida)—9541, 9543, 9546, 9547, 9552.

2a. *Buchnera elongata obtusa* Pennell, var. nov.

*Buchnera angustifolia* Raf., New Fl. Amer. 2: 32. 1837. "In Alabama." Described as with linear leaves, but these remote. Surely an attenuate state of our variety.

(?) *Buchnera levicaulis* Raf., l. c. 39. 1837. "Florida." Description of stem as angular and quite smooth suggests that this may belong to some other genus. However, while our plant is characteristically pubescent, it occasionally occurs nearly glabrous.

Leaves prevailing lanceolate-elliptic, mostly obtuse, only the uppermost linear and then not elongate. Corolla usually smaller than in the species, its lobes usually 4–6 mm. long. Intergrades with the species in southern Florida and the Bahamas.

Type, open sandy pineland, 1–2 miles north of Abita Springs, St. Tammany Parish, Louisiana, collected in flower and fruit August 14, 1912, F. W. Pennell 4190, in herbarium New York Botanical Garden; isotype in herbarium University of Pennsylvania.

Sandy pineland, in the Coastal Plain from North Carolina to southern Florida, westward to southeastern Texas.

Flowering from March to October, and soon ripening fruit; southward throughout the year. Corolla purplish-blue throughout; occurring also frequently in an albino form.

Pennell (North Carolina)—4911. (South Carolina)—4874, 4882. (Georgia)—4730, 4787, 4812. (Florida)—4704, 4722, 9535, 9645, 9674. (Alabama)—4473. (Louisiana)—4190, 4296.

### 35. SCHWALBEA Linné.

*Schwalbea* L., Sp. Pl. 606. 1753.

Type species, *S. americana* L., of Virginia.

#### 1. *Schwalbea australis* Pennell, sp. nov.

Stem 4–8 dm. tall, finely pubescent with short ascending or up-curved hairs. Leaves elliptic-oval, 3–4 cm. long, 12–18 mm. wide, acutish, obscurely reticulate, minutely strigose. Pedicels becoming 4–5 mm. long in fruit. Calyx 10-ridged, its lobes all acute, the posterior linear, 7–10 mm. long, postero-lateral lobes 19–20 mm. long, their free portion 6–7 mm. long, the anterior lobes 20–22 mm. long, united to within 1–2 mm. of their apices. Corolla about 30 mm. long, slender, the lips 10–11 mm. long, the posterior narrowly arched, strongly pubescent externally, the anterior densely lanose within over the bases of the three short lobes. Capsule at least 10 mm. long, not seen mature.

Type, damp pine barrens near Seville, Volusia Co., Florida, collected in flower May 10, 1900, A. H. Curtiss 6742; in herbarium of the New York Botanical Garden.

Distinguished from the northern *S. americana* by the following characters:

Pubescence of stem, pedicels and calyx consisting of recurved hairs.

Leaves elliptic-lanceolate, rarely over 10 mm. wide, usually evidently veined. Anterior calyx-lobes obtuse.

*S. americana.*

Pubescence of stem, pedicels and calyx consisting of upcurved, usually shorter hairs. Leaves elliptic-oval, usually about 15 mm. wide, usually more obscurely veined. Anterior calyx-lobes acute or acutish.

*S. australis.*

Sandy soil, rather moist, oak-land and pine-land, in the Coastal Plain from South Carolina to central Florida and Louisiana; inland apparently occasional, seen only from "sandy humid places in the Cumberland Mountains between Montgomery and Jamestown," Tennessee, collected by Rugel in 1841.

Flowering from April to June. Not seen growing.

### 36. CASTILLEJA Mutis.

*Castilleja* Mutis; L. f. Suppl. 293. 1781.

Type species, *C. fissifolia* L. f., of Colombia.



1. *Castilleja coccinea* (L.) Spreng.

*Bartsia coccinea* L., Sp. Pl. 602. 1753. "Habitat in Virginia, Noveboraco . . . Hort. Cliff. 235." From L., Hort. Cliff. 325. 1737, "Crescit in Virginia, unde delatam communicavit DD. Gronovius". From Gron., Fl. Virg. 69. 1743: "Clayton n. 293." Certainly the plant here considered.

*Castilleja coccinea* (L.) Spreng., Syst. Veg. 2: 775. 1825.

Meadows or moist grassy slopes, loam or sandy loam, in the upland from North Carolina to Alabama.<sup>14</sup> Ranges from Maine to Manitoba, south to Georgia and Kansas.

Flowering from April to early June, and soon ripening fruit. Corolla yellowish-green throughout.

37. *PEDICULARIS* Linné.

*Pedicularis* L., Sp. Pl. 607. 1753.

Type species, *P. palustris* L., of Europe.

Stem 6-8 dm. tall, glabrous. Leaves shallowly lobed, the sinuses narrow, the lobes with minute regular crenations. Bracts auriculate near base. Rachis of inflorescence glabrous. Fused sepals of each side terminating in a slightly enlarged crenate foliar tip, glabrous or with a very few long hairs near base. Corolla with truncate apex of posterior lobes without tooth-like processes. Capsule brown, scarcely exceeding the calyx, slenderly beaked. Flowering in late summer. . . . . 1. *P. lanceolata*.

Stem 1-3 dm. tall, hirsute, especially above. Leaves deeply lobed, the sinuses broad, the lobes with more prominent irregular crenations. Bracts entire near base. Rachis of inflorescence lanate. Fused sepals of each side broadly acute, entire, pubescent along the veins. Corolla with apex of posterior lobes each with a tooth-like process. Capsule straw-colored, twice as long as the calyx, scarcely beaked. Flowering in spring.

2. *P. canadensis*.

1. *Pedicularis lanceolata* Michx.

*Pedicularis lanceolata* Michx., Fl. Bor. Amer. 2: 18. 1803. "Hab. in regione Illinoensi" (A. Michaux). Type not verified, but description distinctive.

Swales and wet meadows, mountains of North Carolina. Ranges from Massachusetts to Manitoba, south to North Carolina and Nebraska.

Flowering from late July to September. Corolla yellow throughout.

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<sup>14</sup> Seen only south to Berkeley Co., lower South Carolina, but this very easily distinguished plant is recorded from upper Georgia by Elliott, Sketch Bot. S. C. and Ga. 2: 132. 1822; and from Etowah Co., Alabama, by Mohr, Contrib. Nat. Herb. 6: 728. 1901.

**2. *Pedicularis canadensis* L.**

*Pedicularis canadensis* L., Mant. 86. 1767. "Habitat in America septentrionali. Kalm."

Woodland or knolls in meadows, throughout above the Fall-line, probably more common northward; in the Coastal Plain descending locally to northern Florida. Ranges from Nova Scotia to Manitoba, south to Florida and Texas.

Pennell (Alabama)—9722. (Tennessee)—9789.

**38. *MELAMPYRUM* Linné.**

*Melampyrum* L., Sp. Pl. 605. 1753.

Type species, *M. cristatum* L., of Europe.

Main stem-leaves linear or lanceolate-linear. Bracts conspicuously fimbriate near base, with teeth frequently as long as the width of the blade. Capsules mostly 6-7 mm. long, curved and usually attenuate-beaked. Seeds 2-2.5 mm. long, brown to blackish. . . . . 1. *M. lineare*.

Main stem-leaves linear-lanceolate to nearly ovate. Bracts slightly or not fimbriate near base, the teeth shorter than the width of the blades. Capsules frequently larger, reaching 8-9 mm. long, slightly or not curved, and less or not attenuate-beaked. Seeds often larger, reaching 3 mm. long, usually black.

1a. *M. lineare latifolium*.

**1. *Melampyrum lineare* Desr.**

*Melampyrum lineare* Desr., Lam., Encyc. 4: 22. 1796. "Rapportée de la Caroline par M. Fraser . . . (v. s.)." Description made from a very young plant, but certainly of the form here considered. Characterization of the calyx as 5-toothed certainly erroneous.

Open woodland, thin acid soil, upland and probably midland districts of North Carolina. In the Appalachians mainly replaced by var. *latifolium*. Ranges northward to Long Island, and through its varieties much further northward and across the continent.

Flowering and fruiting through the summer. Corolla white, more or less pinkish externally, the palate yellow.

**1a. *Melampyrum lineare latifolium* (Muhl.) Beauverd.**

*Melampyrum americanum* Michx., Fl. Bor. Amer. 2: 16. 1803. "Hab. a sinu Hudsonis ad montosam Carolinam." (A. Michaux.) Description evidently of the prevalent inland broader-leaved plant.

*Melampyrum latifolium* Muhl. (Cat. 57. *nomen nudum*); Eaton, Bot. 316. 1818. From Muhlenberg's Catalog, the type station is in Delaware. Type not seen, but evidently is the prevalent inland plant.

*Melampyrum lineare latifolium* (Muhl.) Beauverd, Mem. Soc. Phys. Geneve 38: 474. 1916.

Moist open woodland, in the Appalachians south to northern Georgia. The prevalent inland plant, southward attaining its greatest distinctness from the species.

## NOTES ON NEW JERSEY, PENNSYLVANIA, AND VIRGINIA FISHES

BY HENRY W. FOWLER

The notes and records given below are chiefly gathered from collections made for the Museum of the Academy during 1919. A few others, made previously and used in this connection, are included. An interesting addition to the fauna of New Jersey is recorded, besides notices of rare and little-known species. The records are condensed and exhibit only briefly the more important items in the great mass of material examined. Acknowledgment for assistance in procuring material is herewith given but as the names of most of the contributors have appeared elsewhere the names are not repeated.

## NEW JERSEY.

Material was collected and studied in the field with Dr. R. O. Van Deusen during the past season, in Salem County, as follows: basin of Alloway Creek in Deep Run with its enlarged artificial ponds "Lake Tranquility" and "House's Pond" (August 29); Alloway Creek tidal, "Diamond Pond," and mill-race at Alloway (August 30); "Maskell's Pond," in Stow Creek basin (August 31). In Cumberland County (on September 2): the fresh-waters of the mill-pond at Newport and the brackish and salt estuary of Nantuxent Creek were explored to Delaware Bay.

A few old specimens of New Jersey fishes in the University of Pennsylvania, from Avalon, Beach Haven, Ludlam Bay and Sea Isle City, were examined through the kindness of Dr. J. Percy Moore.

Notes from the excursions of the Philadelphia Aquarium Society to May's Landing, in May, 1919, were sent by Mr. W. T. Innes; others were received from Dr. R. J. Phillips, taken at Corson's Inlet during his summer residence there; and finally Dr. R. O. Van Deusen made a full list of the fishes captured in the nets at Atlantic City during the entire season until November.

*PETROMYZON MARINUS* Linné. Few in the spring at Atlantic City.

*EULAMIA MILBERTI* (Müller and Henle). Large one at Atlantic City during June. Other abundant sharks were *Carcharias taurus*, *Mustelus mustelus*, and *Squalus acanthias*, the last only in the fall, when common.

SPHYRNA ZYGAENA (Linné). Small ones frequent at Atlantic City. Two, each two feet long, angled at Corson's Inlet during August.

RAJA ERINACEA Mitchill. Corson's Inlet. Not at Atlantic City, where *R. ocellata*, *R. eglanteria*, two adult *R. laevis* and *Dasyatis say* were taken.

RHINOPTERA BONASUS (Mitchill). Large one at Atlantic City in August. One of about 60 pounds taken on the oyster-beds off the mouth of Nantuxent Creek on August 30.

ACIPENSER STURIO Linné. Five at Atlantic City early in June.

MEGALOPS ATLANTICUS Valenciennes. Adult in June at Atlantic City. During the spring *Pomolobus mediocris* and *P. pseudoharengus* were common, and *P. aestivalis* irregular through the summer. School of *P. mediocris* at Corson's Inlet in mid-September.

ETRUMEUS SADINA (Mitchill). Nineteen examples from Avalon on August 7, 1892, in the U. of Pa.

POMOLOBUS PSEUDOHARENGUS (Wilson). Deep Run and Alloway Creek; common in spring. At Atlantic City few *Alosa sapidissima* in the spring, and *Brevoortia tyrannus* abundant all summer.

DOROSOMA CEPEDIANUM (LeSueur). Four during September at Atlantic City. Taken at Alloway in October.

ANCHOVIA BROWNII (Gmelin). Eight taken August 7, 1892, at Avalon. In the U. of Pa.

SALMO FARIO Linné. This and the next found in Deep Run above House's Pond, where introduced.

SALVELINUS FONTINALIS (Mitchill).

AMEIURUS CATUS (Linné). Alloway Creek: run five pounds in weight.

AMEIURUS NATALIS (LeSueur). Deep Run, Lake Tranquility, Alloway Creek, and Maskell's Pond.

AMEIURUS NEBULOSUS (LeSueur). Same as above though more abundant.

HYBOGNATHUS NUCHALIS REGIUS (Girard). Alloway Creek.

ABRAMIS CRYSOLEUCAS (Mitchill). May's Landing, Deep Run, Lake Tranquility, Alloway Creek, Diamond Pond, Maskell's Pond.

NOTROPIS HUDSONIUS AMARUS (Girard). Alloway Creek.

CYPRINUS CARPIO Linné. Deep Run and Alloway Creek.

ERIMYZON SUCETTA OBLONGUS (Mitchill). May's Landing, Deep Run, House's Pond, Alloway Creek.

ANGUILLA ROSTRATA (LeSueur). May 20, 1900 at Ludlam Bay; several at Atlantic City during 1919; also Deep Run and House's Pond.

*ESOX AMERICANUS* (Gmelin). May's Landing and Deep Run at Lake Tranquility.

*ESOX TRIDECIMLINEATUS* Mitchill. Deep Run, Alloway Creek and Maskell's Pond.

*UMBRA PYGMAEA* (DeKay). Deep Run at House's Pond.

*FUNDULUS MAJALIS* (Walbaum). Atlantic City.

*FUNDULUS HETEROCLITUS MACROLEPIDOTUS* (Walbaum). Beach Haven and Nantuxent Creek.

*FUNDULUS DIAPHANUS* (Le Sueur). Deep Run and Alloway Creek.

*FUNDULUS LUCIAE* (Baird). Nantuxent Creek delta in salt ponds on the meadows.

*CYPRINODON VARIEGATUS* Lacépède. Ludlam Bay and Atlantic City.

*SYNGNATHUS FUSCUS* Storer. Beach Haven and Ludlam Bay.

*HIPPOCAMPUS HUDSONIUS* DeKay. Two in September, 1919, at Atlantic City.

*APELTES QUADRACUS* (Mitchill). Ludlam Bay.

*STRONGYLURA MARINA* (Walbaum). Manasquan. Small ones abundant at Corson's Inlet.

*STRONGYLURA ACUS* (Lacépède). Five adults in August at Atlantic City.

*MENIDIA MENIDIA NOTATA* (Mitchill). Beach Haven, Nantuxent Creek, Atlantic City.

*MUGIL CUREMA* Valenciennes. Small ones in great schools, at Corson's Inlet. Atlantic City.

*SCOMBER SCOMBRUS* Linné. Fifty barrels reported at Ocean City, June 16, 1919.

*SCOMBER COLIAS* Gmelin. Ludlam Bay. A few in the spring at Atlantic City.

*SARDA SARDA* (Bloch). An interesting young example from Avalon, taken August 8, 1892. In the U. of Pa. It has 14 dark vertical bars on the back. An example of 35 pounds weight taken at Atlantic City during the past summer.

*SCOMBEROMORUS MACULATUS* (Mitchill). Few in spring at Atlantic City.

*TRICHIURUS LEPTURUS* Linné. Two caught in June and one in September, at Atlantic City.

*SERIOLA ZONATA* (Mitchill). Atlantic City, abundant, mostly small.

*DECAPTERUS PUNCTATUS* (Agassiz). One 85 mm. long from Avalon, August 7, 1892, in the U. of Pa. It shows: Head  $3\frac{1}{2}$ ; depth

4½; D. VIII—I, 30; A. II, 23—I; scutes 46+38; snout 3½ in head; eye 3½; maxillary 2½; interorbital 3½; lanceolate rakers 14+30?

*CARANX HIPPOS* (Linné). Atlantic City. Abundant in August and September, mostly small and but few large ones. Adult taken June 16.

*CARANX CRYOS* (Mitchill). Atlantic City. Occasional; at least six captured.

*SELENE VOMER* (Linné). Ludlam Bay, on July 26, 1892; Atlantic City; three caught in September, 1919.

*TRACHINOTUS CAROLINUS* (Linné). Atlantic City. Young very abundant, and 15 to 20 adults during the season, one on June 16.

*POMATOMUS SALTATRIX* (Linné). Atlantic City and Corson's Inlet; small ones very abundant.

*PORONOTUS TRIACANTHUS* (Peck). Sea Isle City and Atlantic City.

*APHREDODERUS SAYANUS* (Gilliams). May's Landing, Deep Run, House's Pond, and Maskell's Pond.

*POMOXIS SPAROIDES* (Lacépède). Deep Run, Alloway Creek, and Alloway.

*ACANTHARCHUS POMOTIS* (Baird). Diamond Pond at Alloway; also New Lisbon in Burlington County, and Franklinville in Gloucester County, and said to be abundant at the last locality. Eight taken in September, 1917 at Willow Grove, in Gloucester County.

*AMBLOPLITES RUPESTRIS* (Rafinesque). Daretown, Salem County (introduced).

*ENNEACANTHUS GLORIOSUS* (Holbrook). May's Landing, Deep Run, House's Pond, Maskell's Pond.

*MESOGONISTIUS CHAETODON* (Baird). May's Landing.

*POMOTIS GIBBOSUS* (Linné). May's Landing, Deep Run, Alloway Creek, Alloway, Maskell's Pond.

*MICROPTERUS SALMOIDES* (Lacépède). Deep Run and Alloway Creek.

*PERCA FLAVESCENS* (Mitchill). Deep Run, Lake Tranquility, Alloway Creek, Alloway, Maskell's Pond.

*BOLEOSOMA NIGRUM OLMSTEDI* (Storer). Alloway Creek.

*BOLEICHTHYS FUSIFORMIS* (Girard). May's Landing.

*ROCCUS LINEATUS* (Bloch). Atlantic City. Fairly common. Ten to 15 pounds, one of 35 pounds.

*MORONE AMERICANA* (Gmelin). Deep Run, Alloway Creek and Atlantic City. *Centropristis striatus* abundant at last locality.

ORTHOPRISTIS CHRYSOPTERUS (Linné). Atlantic City, one in September, also same for *Lagodon rhomboides*. *Stenotomus chrysops* also taken, besides young, at Corson's Inlet.

CYNOSCION REGALIS (Schneider). Atlantic City and Corson's Inlet. At latter, largest eight pounds, in September, and examples of five pounds not scarce.

CYNOSCION NEBULOSUS (Cuvier). Atlantic City, one, and Corson's Inlet, two of three pounds and one of little less than two pounds. All captured in September.

BAIRDIELLA CHRYSURA (Lacépède). Nantuxent Creek and Atlantic City.

SCIAENOPS OCELLATUS (Linné). Atlantic City and Corson's Inlet. Examples 20 to 35 pounds.

MICROPOGON UNDULATUS (Linné). Three at Ocean City on June 16, 1919. Atlantic City, June 15, common. Adults taken inside at Corson's Inlet.

LEIOSTOMUS XANTHURUS Lacépède. Atlantic City and Corson's Inlet. Common. Many large and wounded taken at latter place.

MENTICIRRHUS AMERICANUS (Linné). Corson's Inlet. Spawners arrive little later than in next species.

MENTICIRRHUS SAXATILIS (Schneider). Atlantic City and Corson's Inlet, where spawners arrive in mid-May. Two examples caught in middle of October.

POGONIAS CROMIS (Linné). Common at Atlantic City, though fewer than red drum. Also Corson's Inlet and Ocean City.

UPENEUS PHILLIPSI Fowler. One example in the U. of Pa. 80 mm. long, from Ludlam Bay, July 26, 1892. It shows: Head  $3\frac{1}{4}$ ; depth  $3\frac{1}{2}$ ; D. VIII—I, 8; A. ?, 6; scales in l. l. 34 to caudal base and 4 more on latter; 3 scales above l. l., 6 below; snout  $2\frac{1}{2}$  in head; eye  $3\frac{3}{4}$ ; maxillary 3; interorbital  $3\frac{3}{4}$ ; rakers 6+15, lanceolate. Single row of teeth in upper jaw, and lower teeth biserial. Spinous dorsal shows distinctly two dark longitudinal bands and soft dorsal three. Each caudal lobe with four transverse dark bars. At present body brown on back; belly and under surface brassy. According to a note on the original label "Caudal and dorsals with dark bands, other fins pale. The anal spines torn loose."

TAUTOGOLABRUS ADSPERSUS (Walbaum). Atlantic City and Corson's Inlet. Also *Tautoga onitis*.

CHAETODIPTERUS FABER (Broussonet). Atlantic City, four on June 15, and three in September.

BALISTES CAROLINENSIS Gmelin. One at Atlantic City during the summer.

*STEPHANOLEPIS HISPIDUS* (Linné). This and the next, same locality as last, though only a few.

*ALUTERA SCHOEFFII* (Walbaum).

*LAGOCEPHALUS LAEVIGATUS* (Linné). One at Fortesque by H. E. Dimmick 19½ inches long. Another adult angled in Great Bay, September 28, 1919. It was feeding largely on small amphipods, living in the tubes of various marine worms. Several adults reported from Maurice River Cove during the summer. *Spheroides maculatus* was abundant at Atlantic City.

*CHILOMYCTERUS ATINGA* (Linné). A fine adult example of this tropical fish was sent to the U. of Pa. shortly after its capture August 1, 1900, at Ocean City, by H. Adams. As the species was previously unknown north of Florida, its occurrence in New Jersey is of considerable interest. The original label says, "Caught this afternoon a fish which seems to be very rare here, as no one knows the name of it."

Head 2½; depth 3; D. 12; A. 11; snout 2¼ in head; eye 5¼; mouth width 2½; interorbital 1½. Spines short points covered with skin, wide set. Forehead broad, flat, and interorbital, slightly concave. Three low supraorbital spines, one above opercle and one over gill-opening. Head broad as long, flattened below. Body greatly depressed. Caudal peduncle small, its least depth equals eye. Eye ellipsoid, slightly advanced. Mouth broad, with thick papillose fleshy lips, gape half way to eye. Nostrils before middle of front eye edge. Gill-opening little longer than eye. Skin spongy, thick. Dorsal slightly before anal, and like all fins, rounded. Fully expanded pectoral twice broad as deep. Caudal slightly longer than pectoral.

Color in alcohol dull brownish, with lilac tints on back and upper surface, marked everywhere with jet-black round spots, variable in size, but none larger than pupil. On head above, spots more crowded. Dorsal, caudal and pectoral dull brownish, marked with very small black spots, few also on anal. All spots on fins not extending very near edges. Brown tint of back extends into pale lower color below eye, before gill-opening, behind pectoral base and below dorsal origin. Under surface of body, including mandible, creamy-white, with an occasional scattered black spot. Length 335 mm.

*CHILOMYCTERUS SCHOEFFII* (Walbaum). Atlantic City.

*MOLA MOLA* (Linné). One four feet long ashore near Barnegat Light on July 26, reported by E. P. McCormick. Another, about same size, at Ocean City, early in September, reported by Richard Erskine.



MYOXOCEPHALUS AENEUS (Mitchill). Four at Atlantic City.

CYCLOPTERUS LUMPUS Linné. Adult during August at Atlantic City.

PRIONOTUS EVOLANS STRIGATUS (Cuvier). Ludlam Bay, very abundant at Ocean City in early June, common at Atlantic City and occasional at Corson's Inlet. *P. carolinus* common at Atlantic City.

LEPTECHENEIS NAUCRATES (Linné). Atlantic City.

PARALICHTHYS DENTATUS (Linné). Three, each ten pounds weight, at Corson's Inlet. Abundant at Ocean City with *Lophossetta maculata*; also at Sea Isle City and Atlantic City. At latter place both species, besides *Pseudopleuronectes americanus* and *Achirus fasciatus*.

ASTROSCOPUS GUTTATUS Abbott. One July 23, at Sea Isle City and one at Ocean City, August 17.

POLLACHIUS VIRENS (Linné). One or two at Atlantic City, in May, besides *Microgadus tomcod*, *Gadus callarias*, *Phycis chuss*, *Merluccius bilinearis*, *Opsanus tau* and *Lophius piscatorius*, the last very abundant.

#### PENNSYLVANIA.

During the past spring the following streams in the Delaware River basin of Berks County were visited: headwaters of the Northkill Creek near Strausberg, tributary to the west, and headwaters of the Tulpehocken Creek south of Strausstown. Notes on Paupack Lake in Pike County were sent by Mr. L. Tromner.

Trips were also made into the Susquehanna River basin: in the Little Swatara of Berks County near Schubert (April 28); during early September in Cumberland County in Yellow Breeches Creek at Three Springs and Walnut Bottom, Conodoguinet Creek at Shipensburg, tributary near Carlisle Springs, one at Hogestown and another below; in Franklin County in the Tuscarora headwaters at Concord; in Perry County in Fishing Creek about Keystone.

Finally, the Potomac River basin of Franklin County was examined at Chambersburg in the Conococheague Creek and small tributary to the west of the town, Back Creek or a tributary between Chambersburg and Fort Loudon and its affluent near St. Thomas, and West Branch of the Conococheague at Fort Loudon and near Metal. These were all visited in early September.

SALMO FARIO Linné. Hogestown.

SALVELINUS FONTINALIS (Mitchill). Paupack Lake and Fort Loudon.

- AMEIURUS NEBULOSUS (LeSueur). Same as last.
- SCHILBEODES INSIGNIS (Richardson). Paupack Lake outlet.
- PIMEPHALES NOTATUS (Rafinesque). Conococheague tributary west of Chambersburg, Back Creek and St. Thomas.
- SEMOTILUS BULLARIS (Rafinesque). Paupack Lake.
- SEMOTILUS ATROMACULATUS (Mitchill). Straussberg, Paupack Lake, Walnut Bottom, Chambersburg, Back Creek, St. Thomas, Metal, Concord.
- ABRAMIS CRYSOLEUCAS (Mitchill). Paupack Lake.
- NOTROPIS WHIPPLII ANALOSTANUS (Girard). Schubert.
- NOTROPIS CORNUTUS (Mitchill). Northkill headwaters and Schubert; Chambersburg and Concord.
- NOTROPIS ATHERINOIDES Rafinesque. Back Creek and Fort Loudon.
- ERICYMBA BUCCATA Cope. Conococheague tributary west of Chambersburg and Back Creek.
- RHINICHTHYS CATARACTAE (Valenciennes). Three Springs.
- RHINICHTHYS ATRONASUS (Mitchill). Straussberg, Northkill headwaters, Schubert, Tulpehocken headwaters, Paupack Lake outlet, Three Springs, Walnut Bottom, Shippensburg, Chambersburg and brook to west, Back Creek, St. Thomas, Fort Loudon, Metal, Concord, Carlisle Springs, Hogestown.
- HYBOPSIS KENTUCKIENSIS (Rafinesque). Schubert, Chambersburg, Fort Loudon, Metal, Concord.
- EXOGLOSSUM MAXILLINGUA (LeSueur). Schubert, Chambersburg, Concord and Keystone.
- CATOSTOMUS COMMERSONNII (Lacépède). Schubert, Shippensburg, Back Creek, St. Thomas, Fort Loudon, Concord.
- CATOSTOMUS NIGRICANS LeSueur. Schubert, Back Creek, Fort Loudon, Keystone.
- ANGUILLA ROSTRATA (LeSueur). Paupack Lake. Fort Loudon.
- ESOX AMERICANUS (Gmelin). Northkill Creek headwaters and Three Springs.
- ESOX TRIDECIMLINEATUS Mitchill. Paupack Lake.
- FUNDULUS DIAPHANUS (LeSueur). Northkill Creek headwaters.
- AMBLOPLITES RUPESTRIS (Rafinesque). Chambersburg.
- LEPOMIS AURITUS (Linné). Paupack Lake, Three Springs, Chambersburg, Fort Loudon, Metal, Concord.
- MICROPTERUS DOLOMIEU Lacépède. Paupack Lake.
- MICROPTERUS SALMOIDES (Lacépède). Chambersburg.
- PERCA FLAVESCENS (Mitchill). Paupack Lake.

**BOLEOSOMA NIGRUM OLMSTEDI** (Storer). Northkill Creek headwaters, Schubert, Tulpehocken headwaters, Three Springs, Concord, Carlisle Springs.

**POECILICHTHYS FLABELLARIIS** (Rafinesque). Chambersburg and brook to west, Back Creek, St. Thomas and Fort Loudon.

**COTTUS GRACILIS** Heckel. Chambersburg and tributary below Hogestown.

#### VIRGINIA.

A small collection in the University of Pennsylvania from the oyster-beds near Cape Charles, was obtained by Dr. J. Percy Moore, July 19, 1891. It contains: *Dasyatis say*, *Fundulus majalis*, *F. heteroclitus macrolepidotus*, *Syngnathus fuscus*, *Strongylura marina*, *Menidia beryllina*, *M. menidia notata*, *Scomberomorus maculatus*, *Seriola zonata*, *Poronotus triacanthus*, *Centropristis striatus*, *Orthopristis chrysopterus*, *Stenotomus chrysops*, *Leiostomus xanthurus*, *Micropogon undulatus*, *Gobiosoma bosc*, *Paralichthys dentatus*, *Hypsoblennius hentz* and *Gobiosox strumosus*. I received *Rhinichthys atronasus* from Deerfield, June 23, 1919.

The following reports were ordered to be printed:

#### REPORT OF THE RECORDING SECRETARY.

The Recording Secretary is again indebted to Dr. J. Percy Moore for acting in that office, and to Dr. Philip P. Calvert, who performed the duties of Recorder of the Council, at the meetings during the past year. The statistics of this report have been again prepared by the Assistant Librarian, William J. Fox.

Meetings have been held December 17, 1918; January 21, February 18, March 18, April 15, and November 18, 1919. Communications were made by Messrs. Henry A. Pilsbry, Edgar Fahs Smith, J. W. Harshberger, and Witmer Stone.

Papers for publication have been presented by David Starr Jordan, John W. Harshberger and Vincent G. Burns, Henry W. Fowler, James A. G. Rehn, Julia W. Gardner and T. H. Aldrich. David Starr Jordan and Masamitsu Oshima, Ezra T. Cresson, Jr., and S. Tillman Berry.

Three-hundred and fifty-nine pages and fourteen plates of the PROCEEDINGS were issued.

The Entomological Section (American Entomological Society) has published three-hundred and ninety-six pages and thirty-five plates of its TRANSACTIONS, seventy-eight pages and twenty plates of

MEMOIRS, and three-hundred and four pages and eleven plates of the ENTOMOLOGICAL NEWS.

Of the MANUAL OF CONCHOLOGY, parts 98 and 99, of volume 25, second series, comprising one-hundred and eighty pages and eighteea colored plates, have been issued by Dr. Pilsbry, Curator of Molluscn.

Seven members have been elected during the year, and the deaths of eleven have been announced. Three members have resigned.

The Ludwick Institute Free Lecture Courses were delivered at the Academy, in the evening on Mondays, January 7, to April 22 incl., and in the mornings during the spring at the several High Schools, by Witmer Stone, Henry W. Fowler, James A. G. Rehn, Spencer Trotter, Henry A. Pilsbry, J. Percy Moore, and J. Fletcher Street. All lectures were illustrated by lantern slides.

The Delaware Valley Ornithological Club and the Philadelphia Botanical Club have continued their meetings in the Academy; and meetings of the Women Teachers' Association of Philadelphia, and The State Graduate Nurses' Association, were held in the Lecture Hall.

EDW. J. NOLAN, *Recording Secretary*.

#### REPORT OF THE CORRESPONDING SECRETARY.

Deaths of the following named correspondents were announced during the year. Raphael Blanchard, Frederick DuCane Godman, William J. Farlow, Gustav Retzius, and Ernst Haeckel. No correspondents were elected.

A slight increase in the volume of foreign correspondence reflects the renewal of scientific activities since the cessation of hostilities, but most of the antebellum agencies for effecting scientific cooperation remain disorganized.

There have been no international congresses to which the Academy was invited. An invitation from the Academy of Literature, Sciences, Arts and Agriculture of Metz to participate in the celebration of its reestablishment after forty-nine years of suppression by the German conquerers was received and answered by a congratulatory letter.

A copy of a resolution thanking the Academy for courtesies extended during its convention in Philadelphia was received from the American Association of Museums. In connection with the removal of the offices and exhibits of the Pennsylvania Department of Health a letter expressive of appreciation of favors rendered by the Academy was received from the new Commissioner of Health.

Inquiries for information were answered as usual.

Statistics of the correspondence follow:

Communications received:

Acknowledging the receipt of the Academy's publications.....	107
Transmitting publications to the Academy.....	35
Requesting exchanges or the supply of deficiencies.....	9
Invitations to learned gatherings, celebrations, etc.....	2
Notices of deaths of scientific men.....	4
Circulars concerning the administration of scientific and educational institutions, etc.....	9
Letters from correspondents } .....	48
Miscellaneous letters.....	
Total received.....	214

Communications forwarded:

Acknowledging gifts to the Library.....	789
Requesting the supply of deficiencies.....	131
Acknowledging gifts to the Museum.....	95
Acknowledging photographs and biographies.....	2
Letters of sympathy or congratulation, addresses, etc.....	3
Diplomas and notices of election of correspondents and delegates' credentials	7
Miscellaneous letters.....	117
Annual reports and circulars sent to correspondents.....	280
Total forwarded.....	1424

Respectfully submitted,

J. PERCY MOORE, *Corresponding Secretary.*

### REPORT OF THE LIBRARIAN.

Your Librarian has to again make acknowledgments to the Assistant Librarian, William J. Fox, for performing the duties of the office during the past year. The present report has been prepared entirely by Mr. Fox.

During the past year the additions to the library total 4,824, an increase over the previous year. These consisted of 4,245 pamphlets and parts of periodicals, 490 volumes, 88 maps, and one engraved portrait.

They were received from the following sources:

Exchange.....	2279
Isaiah V. Williamson Fund.....	1303
United States Department of Agriculture.....	452

James Aitken Meigs Fund.....	226
Authors.....	93
United States Department of the Interior.....	38
Pennsylvania State Library.....	34
Editors.....	31
American Entomological Society.....	23
Cornell University Agricultural Experiment Station.....	20
Tennessee State Board of Entomology.....	20
Wistar Institute of Anatomy and Biology.....	18
Imperial Department of Agriculture, British West Indies.....	18
United States Department of Commerce.....	14
Miss Alice J. Smith.....	14
Statens Skögforsökanstalt.....	13
Dr. Henry Skinner.....	14
Utah Agricultural College Experiment Station.....	13
Pan American Scientific Congress.....	11
Samuel G. Gordon.....	11
Colonel George W. Norris.....	11
California State Commission of Horticulture.....	10
North Carolina Geological and Economic Survey.....	7
State Geological Survey, Tennessee.....	7
Secretaria de Agricultura y Fomento, Mexico.....	6
Museum of the American Indian, Heye Foundation.....	6
Trustees of the British Museum.....	6
California Fish and Game Commission.....	5
New York Agricultural Experiment Station.....	5
Publication Committee of the Academy.....	5
Dr. Edward J. Nolan.....	5
Michigan Geological and Biological Survey.....	4
University of Wyoming.....	5
John Lawrence.....	4
Queensland Department of Mines.....	5
Roger Williams Park Museum.....	4
Thomas B. Wilson Fund.....	4
Princeton University Department of Geology.....	4
United States Treasury Department.....	4
Royal Scottish Museum, Edinburgh.....	3
Dr. W. L. Abbott.....	3
Cuerpo de Ingenieros de Minas del Peru.....	3
United States War Department.....	3
Ohara Institut für landwirthschaftliche Forschungen.....	2
Geological Survey of Georgia.....	2
Department of Trade and Customs, Australia.....	2
University of Tennessee.....	2
Argentine Government.....	2
San Diego Museum Association.....	2
Mississippi State Geological Survey.....	2
Iowa Geological Survey.....	2
Mrs. C. J. Pennock.....	2

New York State Archeological Association, Morgan Chapter .....	2
State Board of Charities, New York .....	1
Geological Survey of Great Britain .....	1
Philadelphia Museums .....	1
State Geological Survey of Kansas .....	1
Bristol Museum and Art Gallery .....	1
Delaware County Institute of Science .....	1
Observatorio de Madrid .....	1
Colorado Museum of Natural History .....	1
William J. Fox .....	1
Danish Government .....	1
Botanical Society of America .....	1
Lewis S. Ware .....	1
Deseret Museum .....	1
Louisiana State Museum .....	1
San Diego Society of Natural History .....	1
Westwood Astrophysical Observatory .....	1
Delaware Valley Ornithological Club .....	1
Museum of Comparative Oology .....	1
Bermuda Biological Station for Research .....	1
Entomological Society of Nova Scotia .....	1
Zoological Society of Philadelphia .....	1
Florida State Geological Survey .....	1
New South Wales State Fisheries .....	1
Commissioners on Fisheries and Game, Massachusetts .....	1
St. Louis Natural History Association .....	1
E. R. Squibb and Sons .....	1
United States Brewers' Association .....	1
East Indian Government .....	1
West Virginia Geological Survey .....	1
Escola Superior da Agricultura e Medicina Veterinaria, Nictheroy .....	1
Government of Formosa .....	1
Lithuanian National Council, U. S. A. ....	1
The Peruvian Corporation Ltd. ....	1
Boston City Hospital .....	1
Geological Survey of Alabama .....	1
Mechanics' Institute, San Francisco .....	1
Natural Resources Intelligence Branch, Dep't of the Interior, Canada .....	1
Dr. Harry F. Keller .....	1
New Jersey Department of Conservation and Development .....	1
National Parks Association .....	1

They have been distributed to the various departments of the library as follows;

Journals .....	3248
Agriculture .....	647
Geology .....	317
Botany .....	117
Geography .....	106

General Natural History.....	87
Entomology.....	46
Anatomy and Physiology.....	40
Ornithology.....	36
Voyages and Travels.....	23
Anthropology.....	20
Medicine.....	18
Ichthyology.....	16
Mineralogy.....	17
Bibliography.....	11
Chemistry.....	11
Physical Science.....	10
Conchology.....	9
Helminthology.....	9
Mathematics.....	6
Herpetology.....	5
Mammalogy.....	4
Miscellaneous.....	21

The following journals were added to the library:

Academia de Ciencias exactas, fisica-quimicas y naturales de Zaragoza.  
 Anales Mexicanos de Ciencias, etc., 1 vol., 1860.  
 American Fisheries Society, Transactions.  
 Canadian Field Naturalist. Ottawa.  
 De Re Indica. Caracas.  
 Giornale per la Morfologia dell' Uomo e dei Primati. Pavia.  
 Mexico (El) Antigua. Mexico.  
 Mining Review (South Australia Department of Mines).  
 Musea. Revue de l'Association des Museums de Province. Havre.  
 Museum of Comparative Oology. Journal.  
 Ohara Institut für landwirthschaftliche Forschungen. Berichte.  
 Rivista di Biologia. Roma.  
 Science and Industry. Melbourne.  
 Svenska Vetenskaps Akademiens Protokoll, 1739 och 1741.  
 Treubia. 'sLands Plantentuin te Buitenzorg.

Among the more important works added to the library are:

Leonhard Fuchs, De Stirpium Historia . . . 1542. G. Thuret, Études Phycologiques. J. C. Sepp, Nederlandsche Insecten. 14 vols. 1762-1905.  
 Sven Hedin, Southern Tibet. Hume and Marshall, Game Birds of India. 3 vols. 1879-1881.

Four hundred and ninety-eight volumes have been bound.

Four volumes and 124 parts of periodicals have been returned to the Superintendent of Public Documents at Washington, and 71 volumes and 144 pamphlets have been transferred to the Free Library of Philadelphia, these being non-essential to the Academy's interests.

Part of the book stack has been rearranged to allow for growth in certain departments.



Eight hundred and seventy-four volumes and parts of periodicals were used on the premises by the scientific staff, and 105 volumes were borrowed. No record was kept of books used in the reading room.

The cooperation of Miss H. N. Wardle in the library is thankfully acknowledged.

EDWARD J. NOLAN, *Librarian.*

#### REPORT OF THE CURATORS.

The impossibility of obtaining metal cases and the greatly increased cost of everything connected with museum exhibits have seriously handicapped the Curators in any effort toward the installment of new exhibits during the past year as well as in the better arrangement of the study collections.

It has nevertheless been possible to keep the collections and the buildings in excellent condition, to properly care for all accessions and to make some notable improvements in the quarters of several of the departments.

The removal of the offices of the State Department of Health to Harrisburg on July 1st, last, and the consequent vacating of the rooms which they had occupied for many years made these quarters in the east of the north wing available for museum purposes and the botanical department was immediately installed there. The increased light in these rooms makes them much better suited for the work of the botanical staff and greatly facilitates the consultation of the herbarium. One of the old rooms at the west end of the north wing has been retained as a botanical storage room where collections can be roughly sorted and prepared for mounting.

The other rooms at the west end of the north wing were allotted to the mineralogical and geological department which in turn vacated the room on the fourth floor of the south wing which it had temporarily occupied, and which now reverts to the department of marine invertebrates. A dark room was erected in the new mineralogical quarters and running water was supplied in the herbarium.

The alterations to the heating plant outlined in last years report were completed during the summer and a telephone exchange established on the fourth floor of the middle wing in charge of a stenographer, where the clerical work of the curators can be carried on.

The large plaster shades hung below the ceiling lights on the first floor of the museum were removed as they had proved unsatisfactory and were in danger of falling.

The Indian elephant "Bolivar," which had never been a suitable specimen for mounting, deteriorated to such an extent that it was removed and dismounted during the autumn.

Five storage cases for mollusks and five for birds' nests and eggs, with the necessary trays were secured with the balance of the State appropriation of 1917. The latter have been arranged in the hallway on the fourth floor forming a small room in which the entire oological collection will be arranged.

Special educational exhibits were installed during the spring. One, consisting of mounted wild flowers from the herbarium, was displayed inside the large cases containing the forestry exhibit and was added to from time to time as the season advanced, so that it illustrated at any time the wild flowers to be found in bloom in the vicinity of Philadelphia.

The other consisted of bird skins from the study collection, the winter species being installed first and the others on approximately the date at which they arrive from the South so that the series at all times showed the wild birds to be found about the City. These collections were an innovation and attracted much attention among students of local natural history and the classes of school children which visited the museum in large numbers.

While most of the time of the museum staff was fully occupied in the care of the collections, it was also possible to do considerable field work.

Dr. Stone was granted leave of absence for three months, May 15, to August 15, and visited the Chiricahua Mountains, southern Arizona, the expenses being largely born by the Redfield botanical fund. He obtained a large collection of plants from a region not heretofore represented in the Academy's herbarium, as well as several thousand insects, and many birds, mammals and reptiles. The success of this expedition was largely due to the generosity of Mr. J. Eugene Law of California, who had invited Dr. Stone to be his guest at his camp in the Chiricahuas and did everything in his power to further the interests of the Academy. In the same connection the Academy is under obligations to Mr. Frank H. Hands of Pinery Canyon in the same mountains.

Mr. Morgan Hebard conducted another expedition to the southwestern United States during July, August and September primarily for the collection of Orthoptera visiting such localities as the Death Valley, Mts. Whitney, San Geronio and Charleston. As on previous

trips he generously took Mr. Rehn of the Academy staff with him and shared his collections with the institution.

Local trips were taken by other members of the staff which resulted in the acquirement of much valuable material while collections belonging to other institutions or individuals were identified by our specialists in return for a series of the duplicates.

The details of work in the several departments of the museum follow:

#### MAMMALS.

As in previous years many valuable specimens were received from the Zoological Society of Philadelphia which have been prepared as skins, or skeletons. The taxidermist Mr. McCadden has been constantly engaged upon the preparation of such material and in the cleaning of skeletons obtained in previous years. A large number of such osteological material has thus been added to the study series, and an African Wart Hog and Kinhajou have been mounted during the year.

Specimens were loaned to E. W. Nelson.

#### BIRDS.

A number of valuable local nests and sets of eggs were added to the Delaware Valley Ornithological Club Collection, while to the study collection of skins the most notable accessions were a large series of Colombian birds obtained by purchase from M. A. Carriker; a number of skins from French Guiana and Senegambia presented by the Philadelphia Museums, a collection of local birds, mainly mounted, from Mr. E. W. Woolman and some 200 specimens from Arizona collected by Dr. Stone.

Considerable rearrangement of the study collection was accomplished during the year and much miscellaneous material mounted and unmounted made readily available.

Many specimens received from the Zoological Society were prepared either as skins or osteological specimens which were catalogued and added to the series.

Many ornithologists have studied the collections during the year and specimens were loaned to H. C. Oberholser, and C. B. Cory.

#### REPTILES AND FISHES.

Mr. Henry W. Fowler who has continued in charge of this department reports that a large number of specimens have been received during the year, notable among which have been 30 specimens of

lizards from the Congo region presented by the American Museum of Natural History, a series of reptiles from the Death Valley and other localities in the western United States, collected by Messrs. Hebard and Rehn and 75 specimens of reptiles obtained in Arizona by Dr. Stone. A number of fishes from Pennsylvania and New Jersey were obtained by Mr. Fowler and other local collectors.

During the past year Mr. Fowler has catalogued, determined and labelled 738 specimens of fishes and has published three papers in the Academy's PROCEEDINGS involving the study and identification of many specimens in the collection.

He has also received for study from the U. S. National Museum the fishes obtained by the U. S. Exploring Expedition of 1839 to 1842, upon which he is preparing a report and of which the Academy will receive a duplicate series.

The collections have been consulted by several visiting specialists and material loaned to Alexander Ruthven and Thomas Barbour.

#### MOLLUSKS.

Dr. Henry A. Pilsbry in charge of the department of Mollusks reports that specimens were received during the year from 72 donors, among the more valuable gifts being 646 lots of North American fresh-water shells from Bryant Walker, selected by Dr. Pilsbry, and a series of Arizona shells and alcoholic specimens collected and presented by James H. Ferriss and A. A. Hinkley. Dr. V. Sterki supplied paratypes of numerous species of Sphaeriidæ and Mr. A. A. Hinkley a series of shells from Guatemala including types of new species. Mr. C. T. Simpson presented a large series of the handsome tree snails of Florida from newly explored localities in the Everglades and elsewhere; and substantial additions to the Pennsylvania and New Jersey collections have been made by E. G. Vanatta and Bayard Long.

Studies on the family Pupillidæ have been continued during the year and published in volume XXV of the MANUAL OF CONCHOLOGY which has been completed, the last part being now in press, Dr. C. Montague Cooke having collaborated in the description of the Hawaiian species. Work has also been done on a report on the mollusca of New York and many specimens have been determined for correspondents.

Mr. E. G. Vanatta has continued the arrangement of the collections, the preparation of material for the museum, and has published four short articles on new material received. Miss Ziegler has made good progress in cataloguing the tertiary fossils.

Specimens have been loaned for study to Dr. Paul Bartsch, Mr. J. B. Henderson and Dr. V. Sterki.

#### INSECTS.

Dr. Henry Skinner, head of the Entomological department, reports that as usual a large amount of material has been incorporated in the collections during the year but lack of cases has seriously retarded its arrangement. He has, however, completed the rearrangement of the large group of the exotic Hesperidæ.

Notable additions to the collection have been 75 diptera from the western United States and Alaska from F. M. Jones; some rare East Indian and South American lepidoptera from W. J. Coxey; 356 lepidoptera from Panama and Costa Rica, from D. E. Harrower; a gynandromorphic *Papilio turnus* from G. F. Pettinos, Jr.; a collection from the Chiricahua Mountains, Arizona, from Dr. W. Stone, consisting of about 4000 specimens; a large series of orthoptera and many coleoptera etc., from Morgan Hebard.

Mr. E. T. Cresson, Jr., has prepared a revision of the dipterous family, Sciomyzidæ, which is now in press, while the family Anthomyidæ has been studied by J. R. Malloch. Many new species of diptera have been received in return for identification of material sent by other institutions.

In orthoptera, Mr. J. A. G. Rehn has rearranged several groups so as to admit of the incorporation of newly received or determined material and has mounted and labelled many specimens. His studies during the year have covered the West Indian Blattidæ, African Blattidæ and a revision of the North American Trimerotropi.

Mr. Morgan Hebard, who has continued his researches at the Academy during the year, has completed a study of the Colombian dermaptera and orthoptera and also a monograph of the Blattidæ of Panama, and a report on Mantidæ from Malaysia, Papua and Australia.

Numerous entomologists have studied the collections and specimens were borrowed for study by Chas. Schaeffer and Edw. C. Van Dyke.

#### PLANTS.

The transfer of the herbarium to new quarters at the east end of the north wing, has already been mentioned. Mr. Stewardson Brown, in charge of this department, reports that the general series of plants has been arranged in the three lower rooms, the local collection in the middle room on the upper floor and the cryptogams in the south

room, the deSchweinitz and other historic collections being arranged in a fireproof vault which had been erected there. The north room has been fitted up for the mounting and preparation of specimens.

During the year, Miss Ada Allen, who has continued as an aid in the department, has mounted upwards of 3700 sheets of specimens comprising the remainder of the Joel Carter herbarium exclusive of the local material, 302 specimens from California, and 613 sheets of New England plants both of which were received by purchase. Most of these have been catalogued by Mr. Brown and distributed. Much additional time was spent in the general arrangement of the herbarium in its new quarters.

Mr. Bayard Long has spent much time in the critical study of various groups in the local herbarium and in its general supervision.

Much use has been made of the herbarium by visiting botanists and specimens have been loaned to C. A. Wetherby, M. L. Fernald, W. B. Maxon, C. Schneider, A. L. Grant and F. L. Stevens.

#### MINERALS AND ROCKS.

The change of location in this department to rooms adjacent to the exhibition collections of minerals has been very advantageous as it brings all of the mineralogical and geological material into close association where it is readily available for consultation.

The collection of Pennsylvania minerals has been transferred to the gallery of the mineral hall formerly occupied by the State Department of Health exhibit, where there is abundant room for its expansion.

The Curators are again indebted to Mr. Frank J. Keeley, curator of the William S. Vaux Collections, and to Mr. Samuel G. Gordon, a student of the Jessup Fund, for all the attention that has been given to this department. Mr. Gordon has cared for the various accessions and has completed an examination of the old collections and duplicates stored in the building, preparing the latter for gift or exchange to other institutions. He has also made a number of field trips to various counties in Pennsylvania and obtained many specimens of great value to the State collection.

#### ARCHEOLOGY.

Miss H. N. Wardle, who has cared for the collections in this department, reports that considerable shifting of exhibits has been necessary to make room for accessions or the display of material not hitherto on exhibition, many specimens from the A. H. Gottschall collection of North American Indian material having been thus displayed.

She attended to the packing, transfer and exhibit of a large and very valuable series of shell heap material collected by Mr. Clarence B. Moore on his early explorations in Florida, which was originally presented to the Wagner Free Institute of Science, but which through a generous donation, the Academy was enabled to secure for arrangement with the rest of the Clarence B. Moore collection.

Owing to the coal regulations and other hindrances, Mr. Moore's usual autumn expedition in the southern states was prevented, while his spring exploration in Florida was not very productive, owing to the country visited having been so thoroughly covered by his previous investigations.

WITMER STONE, *Chairman.*

REPORT OF THE CURATOR OF THE WILLIAM S. VAUX COLLECTIONS,  
DECEMBER 1, 1919.

During the past year, the offices of the William S. Vaux Collections have been removed to the northwest corner of the building, where, with ample space, it is hoped to develop an adequate mineralogical laboratory.

All accessions to date, have been incorporated in the collection, after being catalogued and labelled by Mr. Samuel G. Gordon, who has presented the choice of the specimens, thirty-four in all, secured in connection with his collecting trips over the season, including an unrivalled suite of Nesquehonite and other interesting minerals from Pennsylvania localities.

Other gifts were received from the following donors:

Thomas Harvey. Almandite, Columbite, Tourmaline, Beryl, Corundum.—Delaware Co., Penna.

E. S. Moore. Calcite.—Montana.

Bently R. Morrison. Cacoxenite, Apophyllite, Byssolite.—Lancaster County and Chester County, Penna.

Frederick Pierce. Columbite and Monazite.—Boothwyn, Penna.

Washington A. Roebling. Epidismine.—Moore Station, N. J.

Frederick Oldach. Epidismine.—Robeson, Penna.

Twelve specimens were purchased, of which one of the most important was crystallized orpiment from Japan.

Respectfully submitted,

F. J. KEELEY, *Curator, Wm. S. Vaux Collections.*

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REPORTS OF THE SECTIONS.

THE BIOLOGICAL AND MICROSCOPICAL SECTION.—The Biological and Microscopical Section held nine stated meetings during the year.

Weekly excursions were made, except during July and August and the winter months, to various localities, for collecting purposes.

At the suggestion of Mr. H. F. Munro, a class in microscopic technique has been formed and now meets once a month for the purpose of giving instruction to non-members of the Section. The membership now numbers about twenty and is open to all applicants.

Communications on various subjects have been made by the following members of the Section: Messrs. T. Chalkley Palmer, Hugo Bilgram, B. F. Ray, Dr. Thomas Stewart, J. W. Palmer, John G. Rothermel, Walter Palmer, F. J. Keeley, H. F. Munro, W. H. Van Sickel and Charles S. Boyer.

The following donations to the Sections are reported:

From Miss Elizabeth S. Brown, the microscopical collection of Dr. Amos P. Brown, including a Queen Acme microscope, a Leitz mineralogical microscope, a Beck petrographical microscope, twenty-four objectives, a series of accessories and an object cabinet containing about twelve-hundred mounted objects.

From the Estate of Dr. Samuel G. Dixon, a mahogany object cabinet, with about two hundred and seventy-five slides of Bacteria.

The following have been elected officers for the year 1920:

<i>Director</i> .....	J. Cheston Morris, M. D.
<i>Vice-Director</i> .....	T. Chalkley Palmer
<i>Recorder</i> .....	Charles S. Boyer
<i>Corresponding Secretary</i> .....	Walter Palmer
<i>Treasurer</i> .....	Thomas S. Stewart, M. D.
<i>Conservator</i> .....	F. J. Keeley

CHARLES S. BOYER, *Recorder*.

ENTOMOLOGICAL SECTION.—The Section held the usual stated meetings during the year, with an average attendance of eleven persons. Wm. J. Coxey was elected a member and Robert L. Haines, a Contributor. Interesting communications were made by J. A. G. Rehn, Philip Laurent, J. H. West, J. C. Bradley, Henry Skinner, W. J. Chamberlain, P. P. Calvert, Morgan Hebard and J. J. Davis.

The following officers and committees were elected to serve for 1920:

<i>Director</i> .....	Philip Laurent
<i>Vice-Director</i> .....	R. C. Williams, Jr.
<i>Treasurer</i> .....	E. T. Cresson



<i>Conservator</i> .....	Henry Skinner, M. D., Sc. D.
<i>Secretary</i> .....	J. A. G. Rehn
<i>Recorder</i> .....	E. T. Cresson, Jr.
<i>Publication Committee</i> .....	E. T. Cresson, P. P. Calvert, Ph. D., E. T. Cresson, Jr. E. T. CRESSON, JR., <i>Recorder</i> .

**BOTANICAL SECTION.**—Officers to serve for the year 1920 were elected as follows:

<i>Director</i> .....	Joseph Crawford
<i>Vice-Director</i> .....	Alexander MacElwee
<i>Recorder</i> .....	John W. Eckfeldt, M. D.
<i>Treasurer</i> .....	Stewardson Brown
<i>Conservator</i> .....	Stewardson Brown JOHN W. ECKFELDT, M. D., <i>Recorder</i> .

**MINERALOGICAL AND GEOLOGICAL SECTION.**—Owing to the serious illness of the Director, Mr. Benjamin Smith Lyman, no written report was received, but Mr. Frank J. Keeley, the Vice-Director, reported verbally that several meetings had been held, and in conjunction with the Biological and Microscopical Section, twenty-four field excursions had been given. The Officers of the Section are:

<i>Director</i> .....	Benjamin Smith Lyman.
<i>Vice-Director</i> .....	Frank J. Keeley
<i>Recorder and Secretary</i> .....	William B. Davis
<i>Treasurer</i> .....	Benjamin Smith Lyman
<i>Conservator</i> .....	George Vaux, Jr.

**ORNITHOLOGICAL SECTION.**—The Section has continued its function of encouraging ornithological activity at the Academy during the year. The Delaware Valley Ornithological Club has held regular meetings in the ornithological room and has been instrumental in bringing much material to the department and in interesting many persons in its development.

At the annual meeting of the Section the following officers were elected for the year 1920:

<i>Director</i> .....	Spencer Trotter, M. D.
<i>Vice-Director</i> .....	George Spencer Morris
<i>Recorder</i> .....	Stewardson Brown
<i>Secretary</i> .....	William A. Shryock
<i>Treasurer and Conservator</i> .....	Witmer Stone

WITMER STONE, *Conservator*.

The annual election of Officers, Councillors and members of the Committee on Accounts was held December 16th, with the following result:

PRESIDENT.....	John Cadwalader, A. M., LL.D.
VICE-PRESIDENTS.....	Edwin G. Conklin, Ph.D., Sc.D. Henry Skinner, M. D., Sc.D
RECORDING SECRETARY.....	Edward J. Nolan, M. D., Sc.D.
CORRESPONDING SECRETARY.....	J. Percy Moore, Ph.D.
TREASURER.....	George Vaux, Jr.
LIBRARIAN.....	Edward J. Nolan, M. D., Sc.D.
CURATORS.....	Witmer Stone, A. M., Sc. D. Henry A. Pilsbry, Sc. D. Henry Tucker, M. D. Spencer Trotter, M. D.
COUNCILLORS TO SERVE THREE YEARS.....	Edwin S. Dixon. Robert G. LeConte, M. D. George Spencer Morris. George L. Harrison, Jr.
COMMITTEE ON ACCOUNTS.....	Charles Morris. Samuel N. Rhoads. John G. Rothermel. Thomas S. Stewart, M. D. Walter Horstmann.

#### COUNCIL FOR 1920.

*Ex-Officio.*—John Cadwalader, A. M., LL. D., Edwin G. Conklin, Ph. D., Sc. D., Henry Skinner, M. D., Sc. D., Edward J. Nolan, M. D., Sc. D., J. Percy Moore, Ph. D., George Vaux, Jr., Henry A. Pilsbry, Sc. D., Witmer Stone, A. M., Sc. D., Henry Tucker, M. D., Spencer Trotter, M. D.

*To serve three years.*—Edwin S. Dixon, Robert G. LeConte, M. D., George Spencer Morris, George L. Harrison, Jr.

*To serve two years.*—Philip P. Calvert, Ph. D., Frank J. Keeley, Walter Horstmann, T. Chalkley Palmer.

*To serve one year.*—Charles B. Penrose, M. D., LL. D., Ph. D., Charles Morris, William E. Hughes, M. D., Roswell C. Williams, Jr.

COUNCILLOR..... George Vaux, Jr.

## LIBRARY STAFF.

LIBRARIAN..... Edward J. Nolan.  
ASSISTANT LIBRARIAN..... William J. Fox.

## MUSEUM STAFF.

## DEPARTMENT OF VERTEBRATE ZOOLOGY

Witmer Stone, Special Curator.

Henry W. Fowler, Assistant Curator (Reptiles and Fishes).

James A. G. Rehn, Assistant Curator (Mammals).

## DEPARTMENT OF INVERTEBRATE ZOOLOGY (exclusive of Insects)

Henry A. Pilsbry, Special Curator.

Edward G. Vanatta, Assistant Curator.

## DEPARTMENT OF INSECTS

Henry Skinner, Special Curator.

James A. G. Rehn, Assistant Curator.

Ezra T. Cresson, Jr., Assistant Curator.

Morgan Hebard, Research Associate.

## DEPARTMENT OF BOTANY

Stewardson Brown, Assistant Curator (in charge).

Bayard Long, Research Associate.

Ada Allen, Aid.

## DEPARTMENT OF MINERALOGY AND GEOLOGY

Frank J. Keeley, Curator of the William S. Vaux Collections.

Samuel G. Gordon, Aid (in charge of general collection).

## DEPARTMENT OF ARCHEOLOGY

Harriet Newell Wardle, Aid (in charge).

## ARTIST

Helen Winchester.

## TAXIDERMIST

David McCadden.

## STANDING COMMITTEES, 1920.

FINANCE.—Effingham B. Morris, John Cadwalader, A. M., LL. D.,  
Edwin S. Dixon, Walter Horstmann, and the Treasurer.

PUBLICATION.—Henry Skinner, M. D., Sc. D., Witmer Stone, A. M.,  
Sc. D., Henry A. Pilsbry, Sc. D., Edward J. Nolan, M. D., Sc. D.,  
William J. Fox.

LIBRARY.—Henry Tucker, M. D., Frank J. Keeley, Witmer Stone,  
A. M., Sc. D., Spencer Trotter, M. D., T. Chalkley Palmer.

INSTRUCTION AND LECTURES.—Henry Skinner, M. D., Henry A. Pilsbry, Sc. D., Charles Morris, James A. G. Rehn, George S. Morris.

## ELECTIONS IN 1919.

### MEMBERS.

February 18.—W. Judson Coxe.

April 15.—Edgar Fahs Smith.

November 18.—William H. Van Sickel, Walter Palmer, Hampton L. Carson, Anne Hinchman, Arthur Cope Emlen.

### ADDITIONS TO THE MUSEUM

1919.

#### MAMMALS.

MISS M. C. BOOTH. Mole (*Scalopus aquaticus*). Haverford, Penna.

SAMUEL W. GREEN. Skull of Black Bear (*Ursus americanus*). Moscow, Pa.

RICHARD C. HARLON. Woodland Jumping Mouse (*Napaeozapus insignis*). Huntingdon County, Pennsylvania.

PURCHASED. New York Weasel (*Putorius noveboracensis*). State College, Pa.

DR. WITMER STONE. Fifty mammals. Chiricahua Mountains, Arizona.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens prepared as follows: Mounted. Kinkajou (*Potos caudivolvulus*). Skin and Skeleton. Orang-utan (*Pongo pygmaeus*). Huanaco (*Lama glama*). Young male Sumatran Elephant (*Elephas maximus sumatranus*). Skin and skull, Warthog (*Phacochoerus africanus*). Pale Cebus (*Cebus flavescens*). Night Monkey (*Nyctipithecus trivirgatus*). Two Ocelots (*Felis pardalis*). Brazilian Ocelot (*Felis chibiquazou*). Jungle Cat (*Felis chaus*). Young Wild Horse (*Equus preajalskii*). Two warthogs (*Phacochoerus africanus*), 2 male and female. Spring-bok (*Antidorcas euchores*). Red Kangaroo (*Macropus rufus*). Black-tailed Wallaby (*Macropus ualabatus*). Skeleton, Dromedary (*Camelus dromedarius*). Skull, Pigtailed Macaque (*Macaca nemestrina*). Raccoon-like Dog (*Canis procyonoides*).

#### BIRDS.

MRS. HOWARD GAMBLE. Rose-breasted Cockatoo (*Cacatoes roseicapilla*).

CHAS. G. HERMAN. Eighteen skins of birds. Nicaragua.

MRS. EMMA J. LEWIS. Egg of Sulphur-crested Cockatoo.

W. W. MCCALL. Skin of Weaver Finch.

PURCHASED. 650 skins of Colombian birds.

DR. WITMER STONE. Two hundred and two birds and six sets of birds' eggs. Chiricahua Mountains, Arizona.

MRS. E. M. SWAINSON. Mounted Mourning Dove (*Zenaidura macroura*). New York State.

MISS B. TOWN. Several bird skins. New Zealand and New Guinea.

DR. M. P. WARMUTH. Two cases of mounted birds.

E. W. WOOLMAN. Collection of mounted birds and bird skins.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens prepared as follows: Skin and skeleton, Cassowary (*Casuarus* species). Skin and sternum, Horned Screamer (*Chauna chavaria*). Gray-lag Goose (*Anser anser*). Skin, Coscoroba Swan (*Coscoroba coscoroba*). Cereopsis Goose (*Cereopsis novae-hollandiae*). Ruddy Flamingo (*Phoenicopterus ruber*). Stanley's Crane (*Tetrapteryx paradisea*). King Vulture (*Gypaegus papa*). Skull and sternum, Anhinga (*Anhinga anhinga*). Skull, Orinoco Goose (*Alopochen jubata*). Scarlet Ibis (*Guara rubra*). Sarus Crane (*Antigone antigone*). Lilford's Crane (*Grus lilfordi*). Red-sided Eucalyptus (*Electus roratus*). Senegal Parrot (*Poiocephalus senegalensis*). Satin Bower Bird (*Ptilorhynchus violacea*).

#### REPTILES AND AMPHIBIANS.

AMERICAN MUSEUM OF NATURAL HISTORY. Collection of reptiles. Belgian Congo.

G. W. BASSETT. Shell of Box Tortoise. New Jersey.

HEBARD-ACADEMY EXPEDITION OF 1919. Collection of reptiles and amphibians. Arizona, Nevada and California.

RUSSELL ROSENFELDT. Newt (*Diemictylus viridescens*). Massachusetts.

DR. R. W. SHUFFELDT. Gila Monster (*Heloderma suspectum*). Arizona.

DR. WITMER STONE. Seventy-five reptiles and amphibians. Chiricahua Mountains, Arizona.

ALBERT S. THOMPSON. Jar of reptiles and amphibians. Deerfield, Va.

UNIVERSITY OF MICHIGAN MUSEUM (in exchange). *Ranodon* and *Rana*.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Young American Crocodile (*Crocodilus americanus*).

#### FISHES.

WILLIAM DUNCAN. Star Gazer (*Astrospectus guttatus*).

H. W. FOWLER. Five jars of fishes. Bucks, Cumberland and Franklin Counties, Pennsylvania.

HEBARD-ACADEMY EXPEDITION OF 1919. Small lot of fishes. Beatty, Nevada.

MORGAN HEBARD. *Rhombochirus*. Florida. Three jars of fishes. Charlotte Harbor, Florida.

HERMANO APOLINAR MARIA. Catfish. Colombia.

E. S. MATTERN and H. W. FOWLER. Two jars of fishes. Berks County, Pa.

T. L. HANKINSON. Four jars of fishes. Palisades, New Jersey.

W. L. PAULIN. Three *Pterophyllum scalare*.

UNIVERSITY OF MICHIGAN MUSEUM (in exchange). *Etheosoma iowae* and *Calostonus calostomus*.

DR. R. W. VAN DEUSEN and H. W. FOWLER. Three jars of fishes. Cumberland and Salem Counties, New Jersey.

WITMER STONE. Several specimens from the Chiricahua Mts., Arizona.

#### INSECTS

W. L. ABBOTT. One butterfly, San Domingo.

A. R. ALLEN. Seven insects, Texas.

WILLIAM BEUTENMULLER. Twenty Cynipidae.

ANNETTE F. BRAUN. Twenty-four Microlepidoptera, Ohio. Two *Coleophora amaranthella* (paratypes), Ohio.

PHILIP P. CALVERT. *Psilophora maculata* (type), Costa Rica. Eighteen insects, Costa Rica.

JOSÉ CABRERA. Three specimens of Blattidae.

D. M. CASTLE. Twenty-five insects, New Jersey.

T. D. A. COCKRELL. Eighty Hymenoptera, South America.

W. J. COXEY. *Morpho rhelenor*, French Guiana. *Morpho eugenia*, French Guiana.

NINE EXOTIC LEPIDOPTERA. *Antheraea helena*, Australia. Three butterflies from Assam and Java. *Papilio coon*, Java.

W. J. CRESSON, JR. One moth, Swarthmore, Penna.

W. T. DAVIS. *Cacama variegata* (cotype), Texas.

J. H. FERRIS. Four Coleoptera, New Mexico.

EXCHANGE. Sixty butterflies, Utah.

W. J. FOX. Two Coleoptera, Philadelphia.

GEORGE M. GREEN. Fifty-two Coleoptera, United States.

FRANK HAIMBACH. Eight *Catocala*, New Mexico. Two moths, New Jersey.

D. E. HARROWER. Three hundred and fifty-six Lepidoptera, Central America.

TWENTY INSECTS. Central America.

HAWAIIAN SUGAR PLANTER'S ASSOCIATION. Nine Orthoptera, Philippines.

MORGAN HEBARD. Four thousand five hundred Orthoptera, western United States. Twenty-three Orthoptera, Colombia. Two hundred and twenty-five Orthoptera, Mexico and Central America. Nineteen Orthoptera, Japan. Seven Orthoptera, United States. Sixteen Lepidoptera, Florida. One *Plusia*, Florida. Twenty-three insects, Florida. Twenty-two Lepidoptera, Florida. Fifteen Coleoptera, United States. Sixty-three insects, Florida.

HERMAN HORNIG. One hundred and fifty Diptera, Philadelphia.

A. R. ILLIFF. Nineteen Orthoptera, New Mexico.

FRANK M. JONES. Seventy-five Diptera, and 41 Orthoptera, Western United States.

J. N. KNULL. Two *Dicera tepida*, Pennsylvania.

A. W. LINDSEY. Five Hesperidae, South America.

FRANK R. MASON. *Nothus luteus*, California.

LEVI W. MENGEL. One moth, Colombia. *Perisama sinerubra* (type), Bolivia.

R. OTTOLENGUI. Five moths, California.

GEORGE F. PETTINOS, JR. Gynandromorphic *Papilio glaucus*, Merion, Pennsylvania.

PURCHASED. Four hundred and fifty-two Orthoptera, Pará, Brazil. Five hundred and ten Orthoptera, Argentina. Seventeen *Cicada*, sixty-six *Argynnis*, Neuroptera, Colorado.

HENRY SKINNER. Twenty-one insects, White Mountains, New Hampshire. Twenty-one butterflies, Arizona.

STATE DEPARTMENT OF AGRICULTURE. Eight Diptera, Pennsylvania.

WITMER STONE. Four thousand insects from the Chiricahua Mountains, Arizona.

UNIVERSITY OF MICHIGAN. Two hundred and forty-two Diptera, Pennsylvania.

UNIVERSITY OF CALIFORNIA. Eleven Orthoptera, California.

E. C. VAN DYKE. Four Coleoptera, California.

L. H. WELD. Two *Charips leguminosa* (paratypes), Idaho.

JOHN H. WEST. Six *Catocala*, Utah.

## RECENT MOLLUSCA.

- DR. W. L. ABBOTT. Seventy-six trays of shells from Hayti.
- W. O. ABBOTT. Twenty-eight trays of shells from Massachusetts and Pennsylvania.
- JACOB AEBLY. *Ityanassa obsoleta* Say from a duck.
- REGINALD ALLEN. Five species of marine shells.
- A. BAILEY. *Sphaerium sulcatum* Lam. from Columbia, New York.
- F. C. BAKER. Six species of freshwater shells from New York and Illinois.
- DR. FRED BAKER. Four species of shells from Brazil.
- MRS. W. L. BAKER. Twenty-five species of marine shells from Florida.
- NATHAN BANKS. *Bulimulus liquabilis* Rve from near Brownsville, Texas.
- S. S. BERRY. Nine trays of land shells from California.
- DR. J. BEQUAERT. Six species of African land shells.
- HUGO BILGRAM. *Polinices duplicata* Say from Atlantic City, New Jersey.
- LOUIS H. BREGG. Twelve species of land and marine shells.
- DR. W. T. BRIGHAM. Twelve trays of land shells from Hayti.
- MRS. W. A. BRYAN. Twelve trays of shells from New York.
- W. A. BRYAN. Cotypes of *Tapes philippinarum kupa* Bryan from Oahu.
- MRS. H. H. BUCKMAN. *Pyramidula alternata* Say from Au Sable Gorge, New York.
- H. C. BURNUP. Five trays of African land shells.
- DR. P. P. CALVERT. Two species of shells from Costa Rica.
- G. H. CLAPP. *Gastrocopta delicata* Pils from Cat Cay, Bahama Islands.
- W. F. CLAPP. Twenty-five trays of land shells.
- J. B. CLARK. Forty-eight trays of shells from Florida.
- T. D. A. COCKERELL. Two species of land shells.
- EMILY COLLINS COLLECTION. Twenty-eight species of shells.
- PROF. FRANCO CONTRERAS.\* Four species of *Naiades* from Mexico.
- DR. C. M. COOKE. Eighty-five trays of land shells from Vancouver Island and Hawaiian Islands.
- W. J. CRESSON, JR. Two species of marine shells.
- DR. FLORENTINO FELIPPONE. Twelve trays of shells from Uruguay.
- J. H. FERRISS. Eighty-four trays of land shells from South Western United States.
- J. H. FERRISS AND E. HAND. *Vertigo sterkii* Pils from near Kern River, California.
- W. J. FOX. *Limax flavus* L. from Philadelphia, Pennsylvania.
- FRIENDS' CENTRAL SCHOOL. Seven species of marine shells.
- G. M. GREENE. Two species of marine shells.
- J. M. HAWLEY. Two species of land shells from New York.
- MISS HAYES. *Argonauta tuberculosa* Lam.
- MORGAN HEBARD. Twenty-eight trays of shells from Florida.
- J. B. HENDERSON. Ten trays of shells from Cuba and the United States.
- A. A. HINKLEY. Seventy-four trays of shells from Guatemala and Mexico.
- A. A. HINKLEY AND J. H. FERRISS. Eighty-four trays of land shells from Arizona.
- C. W. JOHNSON. *Oliva carulea* Bolt. from New Guinea.
- F. J. KEELEY. Two species of shells from Pennsylvania and Florida.
- C. H. KENNEDY. *Zonitoides arborea* Say from Bay Shore, near Baltimore, Maryland,

BAYARD LONG. Ninety-three trays of shells from the Eastern United States.  
 W. G. MAZYCK. *Polita rhoadsi* Pils. from Williamsburg County. South Carolina.

R. A. MCCONNELL. Four species of Mexican land shells.  
 REV. H. E. MEYER. Fourteen species of land shells.  
 J. B. MOCKRIDGE. Three marine shells from England and Florida.  
 CLARENCE B. MOORE. Forty-two trays of land shells from Florida.  
 F. OLDACH. *Elimia virginica* Gm. Tulpohocken Creek, near Reading, Pennsylvania.

J. M. OSTERGARD. Two species of marine shells from Oahu.  
 DR. H. A. PILSBRY. One hundred and fifty-three trays of shells.  
 PURCHASED. One hundred and fifty-two trays of exotic shells.  
 CHAS. T. RAMSDEN. *Vaginulus* from Cuba.  
 S. N. RHOADS. Seven trays of shells from Guatemala.  
 J. REHN and M. HEBARD. Fourteen trays of shells from Southern United States.

DR. EMMET RIXFORD. *Epiphragmophora* from California.  
 C. T. SIMPSON. Seventy trays of *Liguus* from Florida.  
 BURNETT SMITH. Twenty-four trays of shells from New York.  
 GEO. C. SPENCE. Five species of exotic shells.  
 DR. V. STERKI. Twenty-nine trays of North American shells.  
 DR. WITMER STONE. Twenty-five trays of shells Chiricahau Mts., Arizona.  
 MRS. E. M. SWAINSON. *Turritella duplicata* Lam.  
 E. G. VANATTA. One hundred and six trays of shells.  
 GILBERT VAN INGEN. One hundred and sixty-eight trays of shells from New York.

BRYANT WALKER. Six hundred and forty-six trays of land and fresh water shells.

MISS MARY E. WALKER. Three species of fresh water shells from New York.  
 MISS H. N. WARDLE. Two species of land shells from Pennsylvania.  
 JOSEPH WILLCOX. Five marine shells.  
 GEORGE WILLETT. *Velutina rubra* W. from Forrester Island, Alaska.  
 W. P. WOODRING. *Succinea grosvenori* Lea from Wolf Point, Montana.  
 B. B. WOODWARD. Ten trays of *Pisidium* from Europe.  
 JAMES ZETEK. Forty-nine trays of shells from Panama.

#### OTHER INVERTEBRATES.

L. S. ADAMS. One starfish.  
 MRS. W. L. BAKER. *Balanus galeatus* L., upon gorgonians from Osprey, Florida.  
 J. B. CLARK. One tray of *Lingula* from Florida.  
 R. E. COKER. *Balanus* from near Key West, Florida.  
 DR. FLORENTINO FELIPPONE. Three trays of invertebrates from South America.  
 JARVIS B. GRUBB. One starfish. Cape May, New Jersey.  
 PURCHASED. Nine trays of invertebrates.  
 MRS. MARY LUDWIG SUYDAM. Collection of corals.  
 UNITED STATES NATIONAL MUSEUM. Four species of barnacles from California and Florida.



## FOSSIL INVERTEBRATES.

JAMES B. CLARK. Portion of scapula of fossil elephant (*Elephas*). Near Dawson, Yukon, Alaska.

G. W. BASSETT. *Belemnitella americana* Mort. from a well at Middletown, New Jersey.

J. B. CLARK. Six species of fossil shells from Florida.

T. D. A. COCKERELL. Fourteen fossil insects and two fossil spiders. Florissant, Colorado.

DAVID DALLAM. One fossil.

DR. H. A. PILSBRY. Three species of fossil from Wolcott Creek, New York.

## FOSSIL PLANTS

BRO. G. ARSINE. Two phials of fossil diatoms. Auvergne, France.

## HERBARIUM.

MISS ALICE A. ALBERTSON. Ten specimens from Nantucket, Massachusetts.

GEORGE W. BASSETT. Number of small collections from New Jersey.

SAMUEL N. BAXTER. *Synoplocos paniculata*, cultivated.

WALTER M. BENNER. Four specimens from eastern Pennsylvania.

REV. T. R. BRENDLE. Number of specimens from the Perkiomen Valley, Pennsylvania.

O. H. BROWN. Two hundred and twenty-four specimens from Cape May County, New Jersey.

ELIZABETH S. BROWN. Collection of Myxomycetes of the late Dr. Amos P. Brown.

STEWARTSON BROWN. *Callitriche anatin* from Germantown, Philadelphia.

MACY CARHART. *Gentiana saponaria* from Keyport, New Jersey.

M. CHAPMAN. *Ilex opaca* from Purmont, New Jersey.

MRS. DEVEREUX. Three specimens from Maine, fifty specimens from North Carolina.

MRS. JOSEPH FOX. *Firmiana platinifolia* in fruit, from McPhersonville, South Carolina.

C. D. FRETZ, M. D. Eighteen specimens from Bucks County, Pennsylvania.

MRS. ADELE LEWIS GRANT. 9 species of *Mimulus* from California.

JOHN W. HARSHBERGER, Ph. D. 15 species from Hackensack Marshes, New Jersey.

ARTHUR N. LEEDS. 2 species from eastern Pennsylvania.

CHARLES D. LIPPINCOTT. *Allium tricoccum* from Harrisonville, New Jersey.

S. LLOYD. *Lycopodium obscurum* from Cold Spring, Cape May County, New Jersey.

BAYARD LONG. 36 specimens from New Jersey, Pennsylvania and Delaware.

JOSEPH R. MUMBAUER. *Viola canadensis* and *V. cucullata* from Berks County, Pennsylvania.

ALEXANDER MACELWEE. 14 plants from New Jersey.

REV. J. P. OTIS. *Rumex nuxicanus* and *Vernonia glauca* from New Castle County, Delaware.

T. CHALKLEY PALMER. *Centaureum pulchellum* from Chester County, Pennsylvania.

HAROLD W. PRETZ. 242 specimens, chiefly from Lehigh County, Pennsylvania.

- MISS ALICE L. SMITH. Herbarium of the late Benjamin H. Smith.  
WITMER STONE. Collection of flowering plants and ferns from Cape May, New Jersey. 1002 sheets of plants collected in the Chiricahua Mts., Arizona.  
JOSEPH STAKES. *Veronica tournefortii* from Moorestown, New Jersey.  
H. W. TRUDELL. *Solidago rigida* from Berks County, Pennsylvania.  
S. S. VAN PELT. 2 specimens of local plants  
MORGAN HEBARD. 24 specimens from California.  
NEW YORK BOTANICAL GARDEN. 249 specimens. In exchange.  
UNITED STATES NATIONAL MUSEUM. 16 specimens. In exchange.  
PURCHASED. 1215 plants from North America. Collected by Bayard Long.

## MINERALS.

- BRO. G. ARSINE. Lava with maize impressions. La Soledad, near Morelia, Michoacan, Mexico.  
J. H. DROSSER. Wulfenite crystals. Rodeo, New Mexico.  
SAMUEL G. GORDON. Sixty-eight specimens of minerals from Pennsylvania.  
THOMAS HARVEY. Collection of 3000 Pennsylvania minerals.  
BENTLY R. MORRISON. Collection of minerals, French Creek, Pennsylvania.  
FREDERICK PIERCE. Collection of minerals, Boothwyn, Pennsylvania.  
W. L. STEVENSON. Collection of minerals made by the late W. G. Stevenson.  
MRS. MARY LUDWIG SUYDAM. Collection of minerals.  
H. F. ZERGER. Moss agate, Lancaster County, Pennsylvania.

## ETHNOLOGY AND ARCHEOLOGY.

- MISS VIRGINIA HARTSHORNE. Mummy head and mummy shawl. Egypt.  
CLARENCE B. MOORE. Type collection made by Mr. Moore in his early researches of artifacts from the shell-heaps of Florida.

## PHYSICAL APPARATUS.

- MISS ELIZABETH S. BROWN. Three microscopes, objectives, accessories and miscropic slides, formerly the property of the late Dr. A. P. Brown.  
DR. HERMAN BURGIN. Contact goniometer.

# INDEX TO GENERA, SPECIES, ETC., DESCRIBED AND REFERRED TO IN THE PROCEEDINGS FOR 1919.

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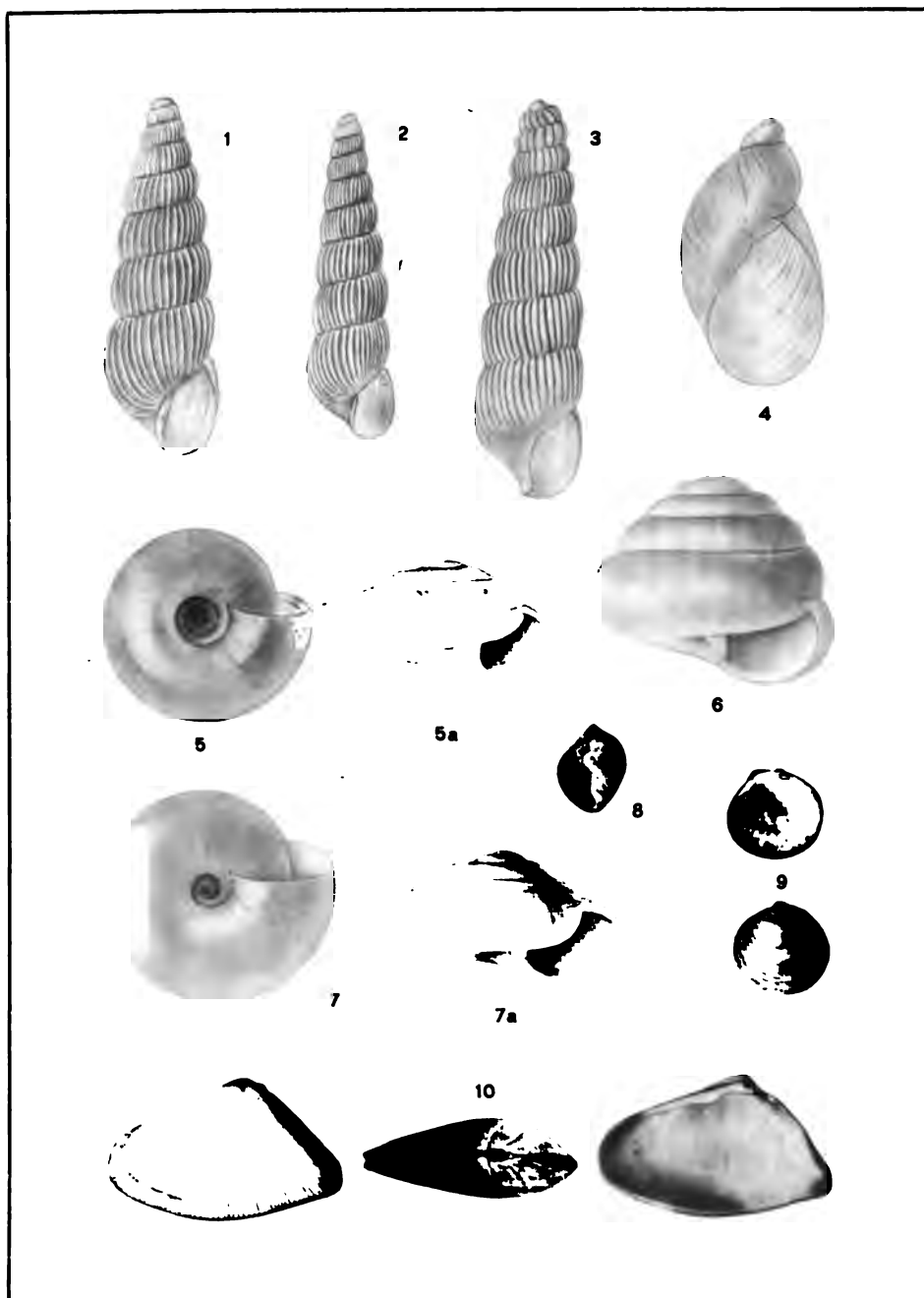
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